NOVEMBER, 1940

Engineering Library

FACTORY

MANAGEMENT and MAINTENANCE

A McGRAW-HILL PUBLICATION

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REMEMBER this Ad on WROUGHT IRON in a RADIANT HEATING INSTALLATION?

IN THE MODERN OFFICE BUILDING OF JOHNSON WAX

BYERS WROUGHT IRON
in a NEW TYPE OF HEATING

FRANK LLOYD WRIGHT ARCHITECT
WESTERLIN & CAMPBELL CO. HEATING CONTRACTORS

BYERS GENUINE WROUGHT IRON
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. . . A large New York State manufacturer is planning on two Radiant Heating installations.

. . . Another large manufacturer, in West Virginia, is contemplating the use of Radiant Heating in an emergency hospital now being designed.

. . . A mid-west concern with a large fleet of trucks is investigating the use of Radiant Heating in a new garage . . . because it promises to solve the difficult heating problem encountered in all such buildings.

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If you are considering

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TUBULAR AND FLAT ROLLED PRODUCTS
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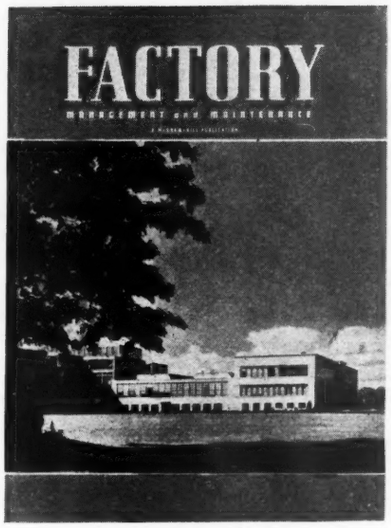

Success or failure of the national defense effort will depend in large measure upon industry's ability to produce machine tools in hitherto unprecedented quantities. Nicely timed, therefore, is this month's full-color photograph of the new Pratt & Whitney plant at West Hartford, Conn., ready to produce its quota. Back of its handsome office building lie almost 700,000 square feet of precision manufacturing facilities—on one level and under one roof. Completed a year ago, the new plant replaces one of 23 multi-story buildings.

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FACTORY

MANAGEMENT and MAINTENANCE

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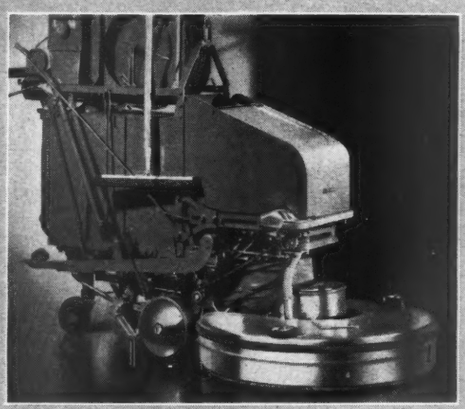

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FACTORY
MANAGEMENT and MAINTENANCE
L. C. MORROW, Editor

Can We Do It in Forty Hours?

Is a 40-hour work week the most productive? Or should the week be lengthened to 44, 48, or even 56? Would "social gains" be lost under a longer work week?

This country is going to have to answer these questions before it writes finis to its great new defense industry. Unless, of course, affairs in Europe drag out long enough to let us mosey along in Walsh-Healey and Wage-Hour Act style.

The Secretary of Labor has pointed out that neither the Walsh-Healey Act nor the Wage-Hour Act prevents working longer than 40 hours, provided only that all hours over 40 must be paid for at time and one-half.

The intent of these laws is obvious. Their objective is to limit the number of hours any individual worker may take out of the hours-of-work bank in order to give more workers opportunity to take out some hours. It is the hope of the legislators that when the process has gone on for some time every employable will have a job. The end result would be a social gain.

Forty hours didn't mean much when the laws were passed. Industry was averaging less than 40 hours. But now conditions are different. There is a new industry—defense—in which time is of the essence. Yet the defense production work must be geared to the learning pace of the unemployed, unless the cost is to be inordinately high.

Quite correctly, the Army and the Navy are saying to industry: "Take these defense orders and get them out quickly." And, unless Army and Navy buying practices have changed greatly, they are also saying, "Keep the price down."

At the same time the government, by the mechanism of its laws, is saying, "Time-and-a-half for more than 40 hours." Which is equivalent to saying that the cost of defense shall be relatively high. That is because industry just can't get along by employing its highly skilled workers only 40 hours. The government itself admits this by raising to 48 hours the work week in its arsenals.

That there can be enough work for all employables at 48 hours seems apparent. There has been no lessening of the need for the normal goods and services of industry. On top of that need has been piled the need for defense equipment. Mathematically, the work is there. Given long enough, technology would do the job even in an extraordinarily short work week. But the only safe assumption is that the time allowance is short indeed. Therefore it would seem to be wise not to maintain our "social gains" at the risk of losing our society itself.

L. C. Morrow

AMERICA TRAINS

A vital bottleneck — skilled labor — confronts industry as defense work gets under way. Government and schools are expanding their plans, but the best training is on the job in the plant. So the big task is industry's — *all* industry's. Herewith accounts of seven successful company programs

INDUSTRIAL MANPOWER is a critical bottleneck of national defense. America's big industrial army—potentially formidable but raw and ill-trained—*must* be drilled at once for the estimated 1,575,000 man-years of skilled and 1,820,000 man-years of semi-skilled work cut out for it in the new defense program.

Good work has been done by the scores of agencies, federal, state, local, and educational, concerned with the problem. But the great responsibility will rest finally with industry itself, because the best training is training *on the job in the plant* or training directly linked to industry's known needs.

Industry is meeting this challenge, although the biggest part of the task still lies ahead. Naturally enough the aircraft makers have come to the fore in training. Their industry, facing further expansion, has a backlog of $2,800,000,000 in orders. It now employs 105,000, against 41,000 last year, and at the peak of the defense program will need at least 350,000 workers—20 percent highly skilled, 80 percent semi-skilled.

Wright Aeronautical Corporation

In this article, FACTORY will review several noteworthy company training programs. An outstanding example is that of the Wright Aeronautical Corporation of Paterson, N. J. Even the special-purpose machines used in mass production of airplane engines require an unusual degree of precision and an exceptional type of worker. Wright, rapidly expanding, was quick to launch an intensive learner program.

Wright learner training begins with a four-week course in the Paterson vocational schools. Students must be between 20 and 30 years of age (average 27), American citizens, and residents of Passaic County. Some preference is given those with dependents and those having high school or college training or a measure of mechanical skill.

The company states its specific needs to the school officials who are thus able to choose men best fitted for individual tasks. Records of applicants are carefully studied and physical examinations are given.

In the first week, devoted to shop science, arithmetic review, the reading of simple blueprints, and the use of gages, about 10 percent of the pupils drop out. The rest begin work on machines, lent by the company, like those they will operate if they qualify for Wright jobs. Many of the instructors also are supplied by the company.

Scrapped parts are sent to the school from the plant to familiarize the students with materials. Soon the men are engaged in actual work on Wright parts, using Wright machines and Wright blueprints. Ratings, given at the end of the course, are checked in the personnel department. The successful student is then ready to work in the plant at tasks assigned according to rating.

For a time the new man stands at the elbow of an experienced operator. Gradually he is permitted to load and unload the machine, clear away chips, take roughing parts, and finally to go it on his own, receiving the minimum operator's rate and his share in the group bonus. Most pupils are ready to work alone within two weeks.

All this is quite separate from Wright's 8,000-hour apprentice course. In still a third category is the "trainee" group, which develops young men of exceptional promise into highly skilled production workers without the formality of the full apprentice course. Many trainees have eventually qualified for supervisory work. Withal the need for supervisory personnel has been acute. Hence the company has designated 18 supervisors as conference leaders who meet with foreman groups to discuss training of workers for advancement.

Wright has also accepted a number of graduates of the private aviation schools for work in the engine test and assembly rooms. To round out its program, it is giving an intensive 10-week course, combined with actual work, to 132 young engineers.

The training problem, however, is not aviation's alone nor should it be confined to the defense industries. The producers of peacetime goods also must build a balanced labor force if we are to have guns *and* butter. This we can do if we increase production on all fronts while holding wage scales and prices in line.

Forstmann Woolen Company

Even industries that feel no shortage of trained men can help, as does The Forstmann Woolen Company of Passaic, N. J. Although it is not currently engaged in defense production, this firm is making a thoughtful contribution to defense training.

The Carl Forstmann Foundation has long provided employees, especially those holding or aspiring to supervisory jobs, with self-improvement courses in machine shop practice and blueprint reading. The company itself (noted for foremanship training under the direction of Glenn Gardiner) has had little need for employee training in recent years. The area is overstocked with skilled textile workers.

Recently the machine shop and blueprint courses were voluntarily thrown open to non-employees, and the enrollment was tripled to about 75. Graduates of the 16-week courses will be free to seek jobs where they like—Forstmann will have no strings on them. Many will doubtless be snapped up by the growing aircraft plants of nearby cities.

Forstmann foremen conduct the courses in the mill's machine shops. Registrants are chosen with great care.

HER INDUSTRIAL ARMY

Aviation, facing a peak need for 350,000 skilled and semi-skilled men, has led the way in training. Some plane makers, like Glenn L. Martin (above) have already quadrupled payrolls. But the big training job is one for peacetime as well as for defense industries

In some quarters, meanwhile, attempts have been made to minimize the seriousness of industry's skilled labor problem. The CIO's *Economic Outlook* disputes flatly the assertion of Defense Commissioner William S. Knudsen that the nation faces a "tight squeeze on skilled labor." Robert J. Watt, of AFL, gives voice to labor's fear of "the possible flooding of the employment market with half-trained, low-priced youths while there are still thousands of well-equipped mechanics looking for employment."

There *are*, on the rolls of government employment offices, 900,000 men classed as skilled and 1,100,000 as semi-skilled workers. But every employment manager knows that these rolls, while valuable, are honeycombed with skill-rusty gaffers and ambitious garage mechanics. The New York newspapers carry want-ads for skilled men placed by firms as much as 1,200 miles away. The radio stations broadcast daily appeals to experienced machinists to register at once with local Federal Civil Service offices.

"The shortage is *not* potential; it exists," is the comment of men in industry who have to fill the jobs.

The Connecticut Plan

As a matter of fact, there was a real need in industry for trained and trainable men *before* the defense program began. Well over a year ago, Governor Baldwin of Connecticut named a Committee to Study Employment headed by a thoughtful young industrialist named Carl A. Gray. After a careful survey, the committee found that there *were* jobs in industry, many jobs, but that masses of the unemployed—skill-rusty older men and untrained youngsters—had given up hoping or hunting for work because they had somehow missed out on the opportunities to acquire or keep a skill.

Thus began, as a re-employment measure, the now-noted "Connecticut Plan." Effective from the start, it really came into its own as defense demands rose. Today it provides a

Harris & Ewing photographs

Appointment of Defense Commission's Training-Within-Industry Committee emphasizes need for linking training to industry's specific needs. Channing R. Dooley of Socony Vacuum (above) and J. W. Dietz of Western Electric (below) head this committee

200-hour course to 500 people a month, preparing them for the swift utilization of industry. Just about *100 percent* of these people get jobs. Connecticut can, and probably will, turn out 15,000 such trainees a year simply by using existing agencies and facilities, without creating anything new or costly.

The Connecticut plan is thoroughly localized. In every community there is an unpaid committee representing industry, organized labor, the American Legion, the school board, the State Employment Service, and so forth, and headed by an unpaid chairman. The committee's job is to determine the known need, actual or expected, of industries in the locality and then to give specific training on specific machines.

In Bridgeport the need may be for airplane riveters, in Hartford for filers on machine guns, in Manchester for sewing machine operators, in any of a dozen other cities for machine shop workers. The plan does not profess to be an educational or even a vocational program; it simply meets the emergency need for competent beginners.

The cash cost of training has been $17 per capita, not including industry's many contributions of instructors, machines, and materials or the rental of public school buildings.

Another noteworthy figure is the administrative cost of the statewide program which, from March 1939 to June 1940, withdrew less than $500 from the state's coffers. It cost more than that, of course, but Chairman Gray and the other commissioners have worked hard without salary and have paid their own expenses.

If the Wright and Connecticut cases suggest one solution to the training problem, through cooperation of industry with public agencies, remember that the training job can be and has been done independently.

The Norton Company

The Norton Company, Worcester, Mass., manufacturer of abrasives and grinding machines, has long maintained an established apprentice program. Because it selects "an unusually high type of boy" and maintains very rigid educational requirements, it has been able to develop skilled machinists in much less than the usual time.

Recently, in view of present needs, the company has instituted a learner program, training both beginners and men of some experience, the latter to specialize in certain lines, such as milling machine operators or grinding hands. Actually the company relates the acceleration of its training to "the more fundamental question of producing more work in a given time and space."

First the learner program. Three or four learners are assigned to a department, usually to the second or third shift, and a good workman is given the task of instructing them. He introduces them to fundamentals as a group, then individualizes his instruction as they begin to progress by themselves.

"In a comparatively short time, perhaps three or four weeks, we find many of these men are able to do simpler jobs in the department without asking for much guidance," the company reports.

An unusual sidelight: Where possible, sons are paired off with fathers for training. The latter take pride in their pupils, coach them at home.

To conserve the accumulated skills of highly trained, all-round men, Norton has worked out the assembly of five of its standard models of grinding machine on a production basis, taking as many as four machines off an intermittently moving line in 24 hours. In this way, jobs of wiring, piping, and simple drilling can be done by newer hands, leaving the more experienced man free for harder tasks.

Still another Norton example of economy in the use of skills:

"We have found it possible to do some jobs on automatic and semi-automatic machinery which formerly were done on hand-operated machines, and we have paid particular attention to tooling jobs to the best advantage. Many jigs and fixtures have been made for parts that were formerly handled individually and where a great deal of set-up time was lost on each part. Further than this, the men of lesser skill can be used on jobs where there are jigs in contrast to a layout job."

Lockheed Aircraft Corporation

The principle of making the best use of skilled men already on the job appears to be growing in practice. The Lockheed Aircraft Corporation makes it a factor in its three-point program for filling the vital 20 percent of jobs that call for high measures of skill. Lockheed's three points are:

1. To make a vigorous search for available skilled men.
2. To find ways of making the best use of such men.
3. To conduct an intensive long-term training program.

Of special interest is the company's handling of the first point. Long lines of job seekers form daily outside the Lockheed plant. The company's personnel men don't wait for them to come in—they go out and interview them. Anyone who may claim special skill (about one in four) is placed in a separate line. From these are chosen the skilled machinists and operators according to a list of requirements furnished daily to the personnel department from the various production heads.

Most of the "bluffers" are weeded out by careful questioning. Others are caught in the personnel testing section where dexterity, temperament, aptitude, and trade knowledge are measured. The qualifiers are quickly hired and assigned in a final interview.

Lockheed gets perhaps half of its new workers in the craft lines by this method. In addition it diligently combs other possible sources such as trade schools, public schools, and public and private employment agencies.

"Machine operators or those who are rusty from lack of employment are encouraged to broaden their skill and so progress to more exacting work," R. Randall Irwin, industrial relations manager, reports. "Wherever possible, skilled all-round men are diluted with less skilled men. In this way, the whole body of skilled workers moves steadily toward higher ratings, making it possible to feed less skilled men into the shop lower down the line."

In conformance with federal and state standards, Lockheed also maintains a vigorous four-year apprentice training program for men between the ages of 18 and 23, at the ratio of one apprentice to 10 journeymen. The company also cooperates with the public school trade extension program. Some 50 percent of the day shift employees attend night classes. To round out its program, Lockheed conducts a school for supervisors to teach methods of developing skill and leadership to the utmost in workers of the lower grades.

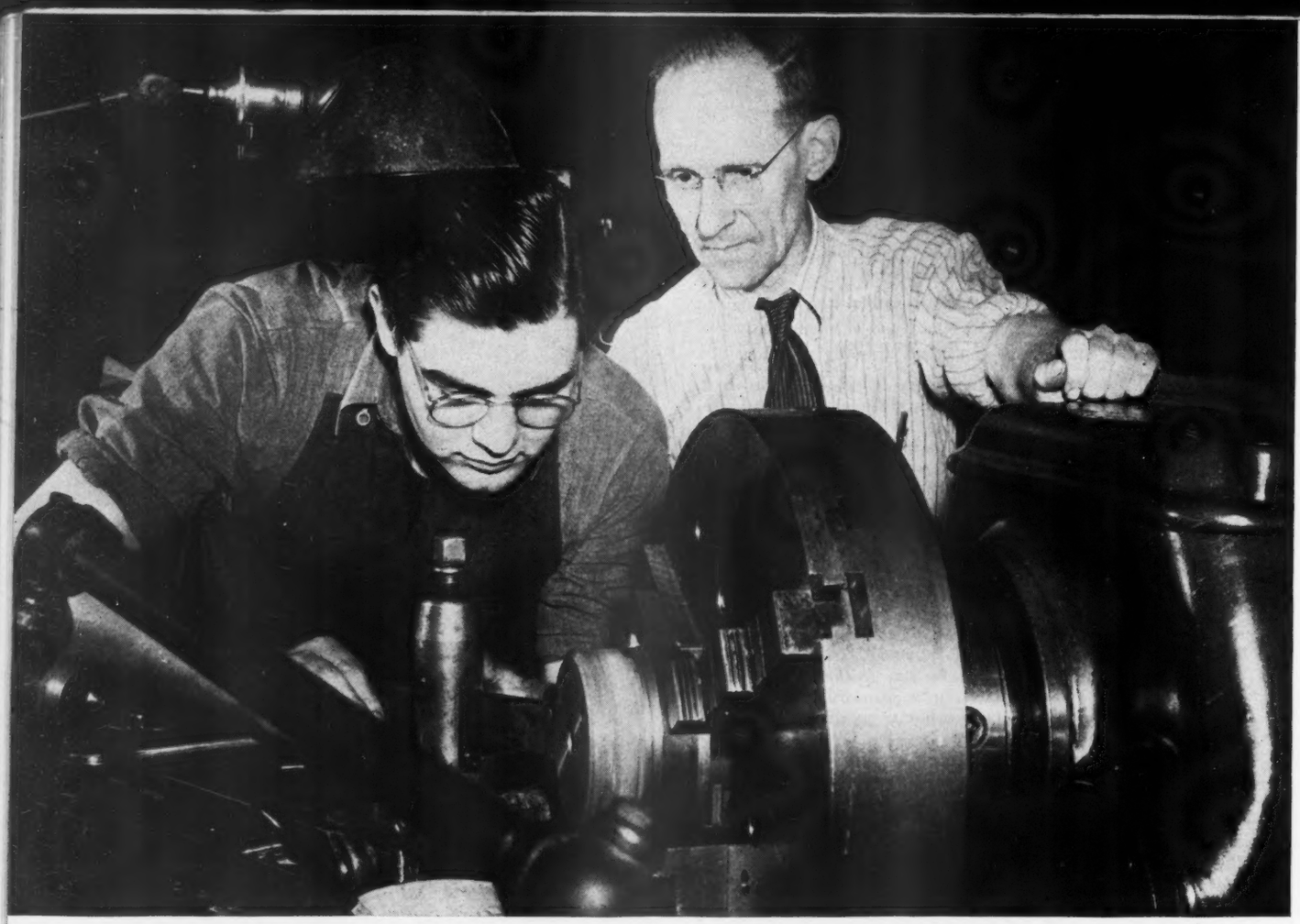
Millions are being spent and thousands of men are receiving some form of training under the programs conducted by the several federal government agencies that have a connection with the defense labor problem. When the National Defense Advisory Commission took shape and Sidney Hillman was named as labor member, a program for the immediate training of 150,000 and the ultimate training of 1,500,000 was recommended at once.

WPA, NYA, CCC, and Others

The Works Progress Administration, the National Youth Administration, the Civilian Conservation Corps, the United States Employment Service, the Federal Committee on Apprenticeship of the Department of Labor, and the United States Office of Education have all had a logical finger in the pie either because of their contact with the vast reservoir of the nation's unemployed or because they have already been engaged in giving or fostering some sort of training. As defense speeded up, all made plans to stress training and placement work.

The relationship of these organizations to one another and to the countless state, county, and municipal institutions that have always given vocational training—and the connection of all with industry and organized labor—

Above, a father trains a son. This, whenever possible, is Norton Company policy. Dads take pride in pupils, encourage homework. Below, at Curtiss Aeroplane Division's Training School these lads have learned to rivet reinforcements with a vibrator gun



Learning by doing is a key principle in Westinghouse Electric's two- and four-year apprentice courses. In 25 years this school has graduated 9,000, half of whom now hold supervisory posts. Since the defense program started, the enrollment has been doubled

was a difficult thing to define even before the defense program. The task of coordinating the national training effort has been assigned by Hillman to Owen D. Young, former chairman of General Electric. The job is not an easy one and will not be done in a day. The Defense Commission's position, never forget, is, in this as in other things, advisory.

However, there is flowing, or will presently flow, from the federal agencies a large quantity of partly trained or trainable manpower much of which industry can use. Management should look upon the products of these programs as potentially valuable raw material on which basic work has been done.

As early as July, Hillman, after conferring with leading industrialists and labor leaders, agreed that training *on the job* was the big thing. And in late September the emphasis swung back to this point with the announcement of the formation of the Training-Within-Industry Advisory Committee of the Defense Commission staff.

Channing R. Dooley of Socony Vacuum was named head of this committee, aided by J. W. Dietz of Western Electric. On "loan" from their companies, Mr. Dooley and Mr. Dietz settled down in Washington where, as the outlines of their program unfolded, it became evident that here was quite the biggest development on the whole training front.

To begin with it will fill what is probably the biggest need—that of bringing the raw material across the threshold of industry and into the plants. This has been done sporadically in certain states and cities, especially in Connecticut, but it needs to be done on a national scale without the loss of a moment's time.

In so doing, the Dooley committee will perforce achieve a coordination of government and scholastic training efforts that nothing else could possibly bring about because it will pull all the separate agencies closer to industry, allowing each to demonstrate its greatest actual usefulness.

On September 25 the Training-Within-Industry group announced a new approach, the "upgrading plan" to encourage defense industries to utilize the skills of employees to the fullest degree. Pointing out that many a highly skilled worker spends 75 percent of his time at less exacting tasks, the committeemen asserted that "upgrading" will enable him to devote all his time to work that others can't do. Of a piece with this is the breaking down of skilled jobs into their component skills and the training of unskilled men to do each part.

Moving Up Rung by Rung

"Likewise the new employee will be taught not only a single basic operation but also its relationship to others in the total process and will thus prepare himself to move up rung by rung on the ladder of promotion and progress," the committee's announcement said. "By the same token the worker in the intermediate grades, under the guidance and stimulus of this 'training for the best you can do' technique can be transferred upward from light machine operations to more complicated tasks. Similarly, apprentices who comprise a small, carefully selected group, will

acquire all-round skills qualifying them for assignments demanding more versatility. This, in turn, becomes a 'feeder' for further 'training up.'"

Will Aid Management

But more important still was the announcement of a four-point program to link government training closer to management and to unify management's own all-important training activities. In each of 20 cities, Mr. Dooley will appoint district representatives, *drawn from industry* and specially qualified by experience. These men will set up shop (on a part-time basis, to be sure) with the aid of a training consultant, an office assistant, a panel of 10 personnel and training counselors also drawn from industry, and four advisors, two from management and two from labor.

The names of the 20 district supervisors will probably have been announced by the time this article appears. In addition to fostering the upgrading plan, here is the vital four-point job they will undertake:

1. To assist management to analyze training needs both for workers and supervisors.

2. To help create training procedures "custom built" to each individual plant's requirements.

3. To make available to management the experience of other employers.

4. To acquaint plant managements with the availability of tax-supported government agencies, such as the state and federal employment services, the vocational and trade schools, engineering colleges, NYA, CCC, WPA, so that the fullest use can be made of them.

Present at the meeting at which this program was announced were some noted representatives of management and labor whose influence should be a material aid to cooperation in the field. When set up, the committee's organization will be such that any manufacturer can telephone the nearest district supervisor and get prompt, detailed, exact advice on training methods in use by other companies having problems similar to his own; on the best way in which to utilize federal and local agencies engaged in training; and the best way to begin training courses to meet his specific needs.

The problem of supervisory training—a potential bottleneck as serious as any—is also on the committee's agenda. Not one to act unthinkingly, Mr. Dooley has begun formulation of a program, but has withheld announcement to allow for thorough discussion with his aides and advisors. In due time the committee is also

CCC's 43,000 pieces of automotive equipment are serviced by the boys themselves. Most CCC training is not on production lines but may help some day to ease pressure on industry's skilled labor supply by providing thousands of good maintenance mechanics

expected to give attention to the question of transferring the skill from the worker to the mechanism, as can be done by teaching an untrained worker to use a single gage, for example, thus qualifying him for a simple inspection job.

Of interest to management are the plans of two big companies and a small New England industrial city, each meeting the defense training problem in its own way.

Westinghouse

The Westinghouse Electric and Manufacturing Company is a key company in the national defense program with facilities that have already brought in huge orders for turbines, gears, switchboards, radio and gun equipment, and the like. Yet no speed-up is contemplated in the existing two- and four-year apprentice courses.

The enrollment, however, has been doubled to a total of 500. Most of these will be trained at the East Pittsburgh works while lesser expansion is planned at Baltimore, Springfield, Mass., and Philadelphia. At the same time the four-year course has been made more comprehensive by the addition of advanced courses in mechanical drawing and mathematics. Entrance requirements have been stiffened.

In the past, many four-year graduates eventually became machine operators, sheet metal workers, assemblers, and winders. Especially to fill the need for workers of this class the two-year course was instituted. Now the four-year men are trained as machinist journeymen, toolmakers, diemakers, pattern makers, printers, and powerhouse operators. The two-year men—who must also be high school graduates—are given basic mechanical training and special training in the handling of two or three machine tools in addition to their courses in the expert operation of certain machines.

During the last 25 years, about 9,000 men have been graduated from the Westinghouse apprentice schools and today about 50 percent of them hold supervisory jobs. Supervisory training is conducted by a special company committee under a program of the Sales Analysis Institute. Soon "leadership" training will be given to a selected group through an extension course of Pennsylvania State College.

"Up-grading" of workers, the company says, has long been a Westinghouse policy as has the division of skilled jobs into elementary jobs, especially tool making.

Springfield, Vermont

Here is an outstanding case of community cooperation for training in a small industrial town in a rural area. Since July 1, Springfield has been one of five Vermont communities offering free, full-time, pre-employment training for machine operators for national defense work.

This is in addition to the regular machinist-apprentice vocational training course, leading to a high school diploma, which the three Springfield machine shops have maintained in cooperation with the local high school since 1913.

The new special course includes 45 hours of intensive instruction a week for three weeks followed by one week's observation of actual production work. Five trainees a week are carefully chosen by the employment managers of the machine shops. Farm boys and garage mechanics predominate. They are 18 to 35 years old. Few have had shop experience.

Instruction is given at night in the high school shop on the same machinery used by day in the regular high school apprentice course. The teacher, lent from the engineering department of one of the local shops, has had four years' experience in charge of the daytime course.

The trainees are introduced to operation of engine lathe, drillpress, horizontal and vertical boring mills, turret lathe, planer, and shaper, together with bench work and micrometer reading. They are unpaid during the course but may begin production work before its conclusion if they show exceptional aptitude. In any case, foremen and employment managers keep close watch on the group and nearly all the trainees get jobs. The Fellows Gear Shaper Company reports that the course, having already enrolled over 100 men, will continue this winter with an average attendance of 20.

The program is carried on under supervision of state vocational officials. The federal government bears the cost of light, power, materials, maintenance, and instructor's salary.

Sperry Gyroscope Company

A peculiar problem confronted this Brooklyn, N. Y., organization, fast expanding on defense orders. A need for instrument assemblers developed far in excess of the supply. The work is extremely exacting and cannot practically be divided into separate and lesser skilled operations. The problem, therefore, is to find men of some skill and raise them to the special requirements of this job.

The personnel department seeks out applicants with a considerable degree of experience in allied lines, taking also a few men with fundamental machine shop training. Assemblers must be able to solder, file, ream, pin, lap, drill, turn, mill, and perform similar bench operations. Candidates are carefully chosen. Performance tests are used.

Trainees are assigned in small groups to a separate bench in the assembly department and put to work at once—at hourly rates—with the necessary parts, tools, equipment, operation sheets, and blueprints. Although they are given only the less important sub-assemblies to handle, the men work slowly at first because they must follow rigid precision standards. Frequently they take a day or more to finish a job which, within a week, they may be turning out in an hour.

Presiding over the trainees' table is a highly skilled worker chosen for his ability to teach. The new men consult him as they go along. When they begin to gain in proficiency, he is able to return to his own work subject to call from them. All the trainees are on three months' probation and are graded informally during this period by the instructor and the foreman.

This economical form of training makes it possible for Sperry's exceptionally skilled men to concentrate on the hardest assembly tasks, many of which can only be done after two years of experience in the department.

Some Conclusions

A point stressed in nearly all reports of successful training programs is careful selection of trainees. There is a wide and costly margin of error in the time required to develop apt, as against inept, trainees.

As industry gets deeper into the training problem it is apparent also that primary emphasis will be laid on the need for keying the vocational training given by schools and public agencies to the exact needs of the individual industry. This point will be brought out even more strongly as the Training-Within-Industry Committee swings into action. Within the committee it is held that training attuned to specific needs will prove almost 100 percent effective, whereas training unrelated to definite requirements may be no better than 50 percent practical.

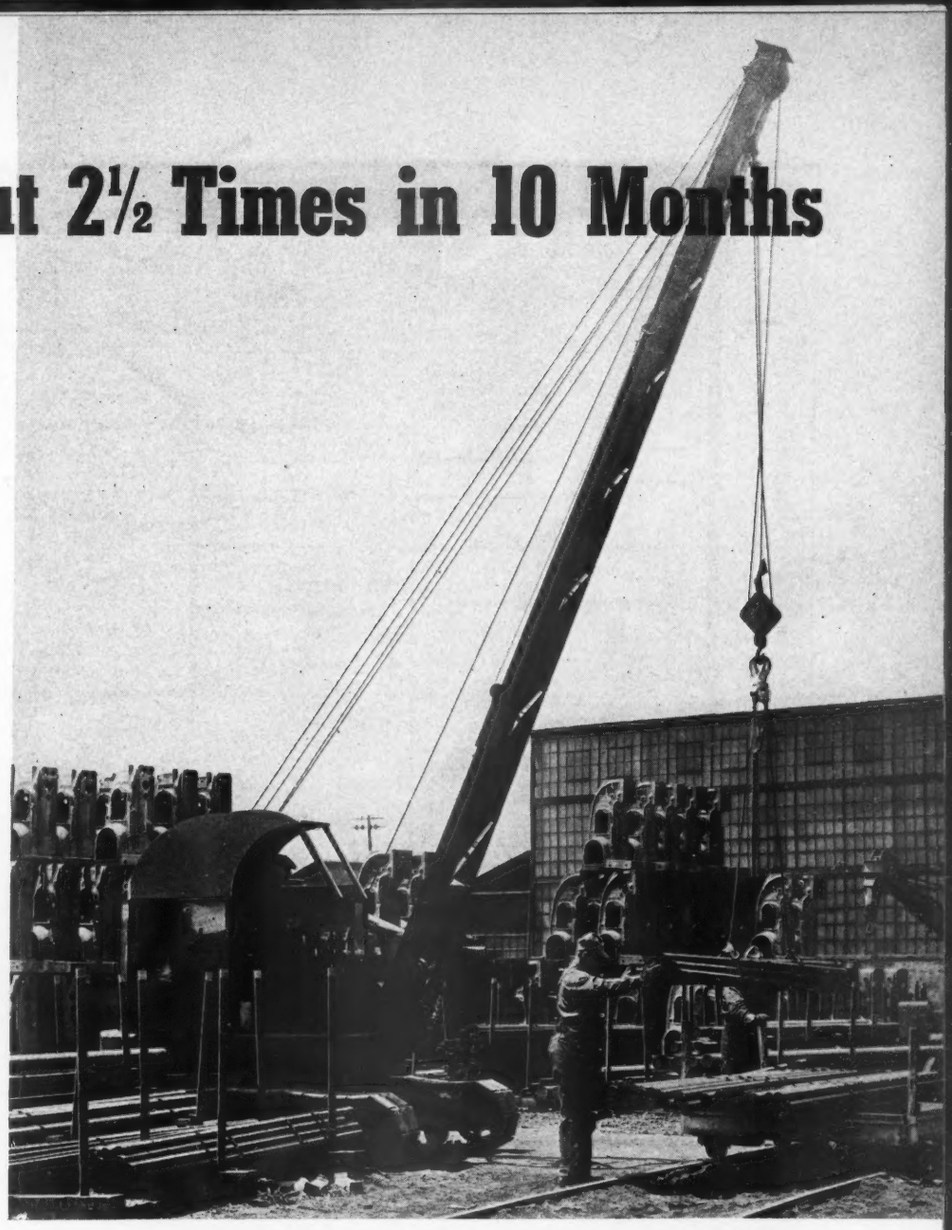
Industry *will* go deeper into the training problem and that soon. As it does, many of the old concepts may be upset. Apprentice training, so long considered a four-year job, will be stripped down—as it already has in some instances—to three and even two years. Students of the problem believe that apprentice systems will survive, however, but that there will grow parallel to them a network of quick-training and informal upgrading plans in proportion to the growing demand. Those who might normally oppose this trend perforce step aside. Traditional concepts must yield to emergencies.

The job, to repeat, is one not alone for the defense industries but for *all* industry. Failure at this vital point may someday be reflected in the defeat of ill-equipped fighting forces or in the economic defeat of the nation at home and in world markets.

Upped Output 2½ Times in 10 Months

When the nation's need for increased output forces your plant to double and redouble its production, look (as this machine tool builder did) to new handling equipment and faster movement of materials and parts for the best part of the answer

C. R. HOCHMUTH
Assistant Works Manager
Kearney & Trecker Corporation
Milwaukee



While crawler crane unloads heavy materials from cars and trucks and piles them in yard piles up to 30 feet high, the smaller tractor-mounted crane at the right takes care of lighter loads, tows a trailer, and spots freight cars on the siding

DURING THE PAST ten months, Kearney & Trecker Corporation has met the heaviest demand upon its production facilities in its 42-year operating history. With the addition of 90,000 square feet of plant space, 227 new units of production machinery, and over 1,100 new employees to the payroll, the company has accomplished a 240 percent increase over 1939's average production.

In planning the reorganized production facilities, particular attention was given to the materials handling problem. The myriad of machining, inspection, heat-treating, grinding, and lapping operations involved in the completion of precision milling machines makes the matter of handling and intermediate storage an extremely important item in both time and cost. From receiving yard to shipping dock, the handling and storage requirements of every department were analyzed, new equipment and methods selected, and all operations coordinated for efficient, trouble-free handling.

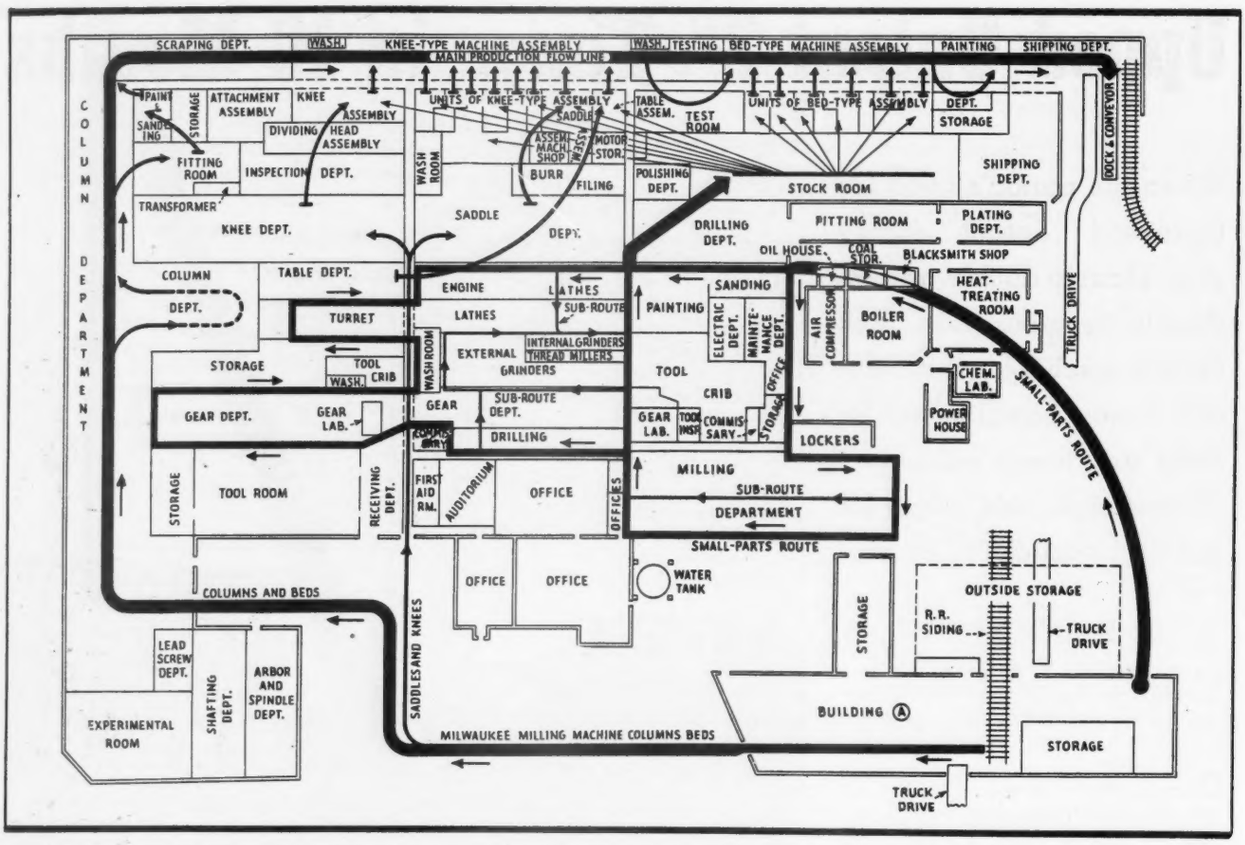
Bottleneck in Receiving

The receiving department presented a particularly difficult problem. The increased load on production operations could be spread over three shifts, but as incoming shipments are limited by circumstances to one 8-hr. period out of the 24, the receiving department's load increased all out of proportion to the rising production rate. For example, the tonnage of gray-iron castings received during September, 1939, was 397.4, or slightly over 2.25 tons per working hour. In April of this year this had jumped to 1,733.6 tons for the month, or 9.4 tons per hour—nearly 400 percent—and increase of other materials was in proportion.

Incoming shipments naturally did not match production requirements; advance buying was necessary on many materials of which prolonged shortages might occur. Consequently it was imperative that an adequate storage "surge tank" be created between the widely fluctuating amounts and kinds of materials received and the smooth flow of production through the plant.

The main requirements to be met by this primary storage system was large capacity, great flexibility, and fast, efficient handling. The first two requirements were to some extent being met with the existing outside storage area adjoining the building housing the receiving department offices, truck weighing scales, cleaning operations, and initial rough machining operations. This yard is served by railroad spur and truck driveways. Materials handled and stored included castings weighing from 1 pound to 3 tons, bar and round stock in assorted lengths (some weighing several tons), and a wide range of supplies. The yard was ideally suited to the new situation, for there were no posts, columns, or walls to limit storage arrangement and there was a virtual "sky limit" on vertical piling.

This need for flexibility and capacity naturally affected equipment selection; installation of stationary jib cranes, craneways, or even paved aisles would rob the yard system of its primary advantage of flexibility. The situation was further complicated by the variety of incoming vehicles to be unloaded—



shipments on gondola, box, and flat cars, truck vans, and stake-bed trucks had to be handled with equal facility.

A tractor-mounted crane previously used in the yard handled most of these conditions excellently, but the new loads and the necessity for high piling were beyond its capacity. So a crawler crane with a 28-ft. boom was purchased. This machine handles loads up to 4 tons, can pile stock up to 30 feet above ground level, and can travel to any point in the yard over the ordinary dirt "floor" regardless of weather conditions. A full-revolving type, it unloads from cars or trucks and places materials directly on the stockpile anywhere within a radius of 50 or 60 feet on either side of the track or drive.

The tractor crane now handles the lighter loads, spots cars on the spur track, and hauls a flat-bed trailer transporting materials. Main transportation is provided by two gas-engined industrial tractors which operate a "shuttle service" between the storage yard and the main plant across the street. For several months these tractors have been averaging 30 trips per shift, 3 shifts per day.

Castings are removed from stockpiles as required, loaded by crane on the small trucks which are hauled by tractor into Building *A*. Here a new high-capacity shotblasting unit removes all rust incidental to outside storage. Following this operation, castings are chipped, scaled, rough-machined, and painted before going via tractor-truck to the main plant across the street.

Bar stock is piled in simple racks, from which it is removed by crane and fed to a roller rack leading to the first inspection room in Building *A*. A small end section is cut off for analysis and testing. Test-result symbols are stamped on the remaining bar which then goes to cutoff saws and rough machining.

Crawler Crane Fast Unloader

Building *A* also houses the main under-roof storage area for polished and ground bar stock and other materials unsuited to outside exposure. The entire length of the building is served by an overhead traveling crane, and wide aisles have been provided for tractor-truck transport through the building. The yard spur track extends into the building, terminating at the platform scales which weigh loads brought in by tractor-hauled trucks from the yard.

This new set-up nicely met all requirements. The wide range of the crawler crane permits stockpiling over an ample area of the yard without rehandling, and leaves all piles readily accessible for prompt withdrawals. Entire carloads of assorted bar stock may be unloaded and properly stockpiled in less than two hours. The efficiency of the system is evidenced by the fact that the crane and its operator were the sole additions to yard equipment and payroll to meet a 400 percent increase in handling load.

By locating the 51 operating departments according to a carefully studied plan for sequence of operations, virtual straight-line production resulted which reduced over-all movement to a minimum (see the layout). To cut down intermediate storage requirements and save valuable floor space for production operations, the former job-order system was superseded by a new production control on a "sequence-order" basis. This method is designed around time studies of all operations involved in completing each type of milling machine manufactured, and provides automatic scheduling of operations on each job lot so that all parts are completed to reach unit and final assembly points in the order and at the time required.

Except in the small-parts manufacturing and certain subassembly departments, heavy weights must be handled, so particular emphasis has been placed on crane and hoist equipment. Every bay in the original plant was served by traveling cranes, and all heavy machining operations were equipped with swinging-boom jib cranes. Ten cab-type and five floor-controlled traveling cranes were purchased for the plant addition, and nine more jib cranes installed.

In the assembly line machines are put together on wheel-mounted beds which can be moved easily along rails set in the floor

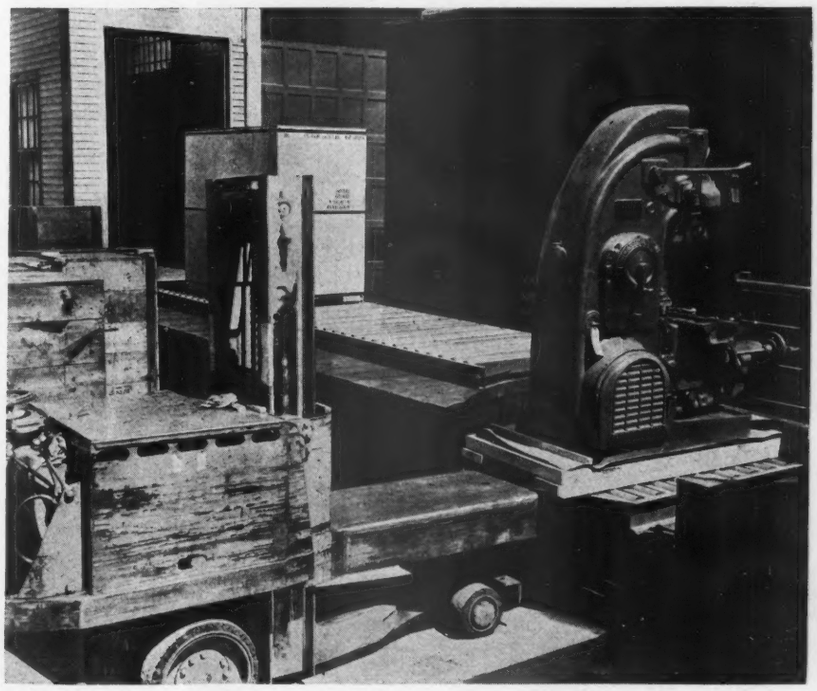
Electric trucks were used to move tote boxes and special small-parts racks; five such trucks were added to the existing fleet.

An assembly line consisting of wheel-mounted beds operating on rails set in the floor is provided for the main assembly section. This carries through assembly, final inspection, and painting operations, terminating at the crating section of the shipping department, and is served by four overhead cranes.

Occupying the end section of the final assembly bay, the shipping department is the final link in the handling system. Overhead cranes traveling the full length of the building are used for handling during crating. To place cases on the loading dock, a heavy-duty roller conveyor has been installed. The loading dock lies between the spur track and the truck drive; it extends into the shipping yard and can accommodate three cars simultaneously. There is room for one car in the building, the rest of the dock being in the open.

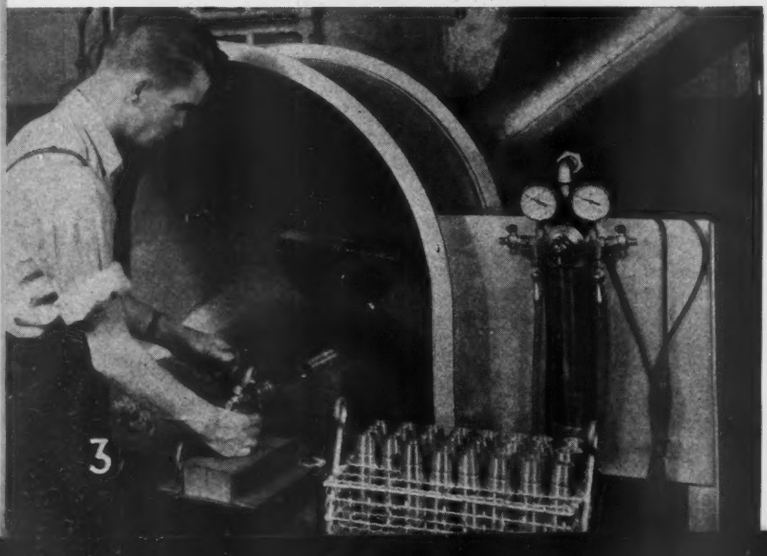
An innovation in handling equipment is the hydraulic-operated hoist and turntable which is an integral part

(*Continued on page* 136)



Hydraulic hoist and turntable on loading dock receives completed machines from roller conveyor, lowers them to truck level, swings them around to proper handling position. Small electric winch at end of dock pulls heavy machines along conveyor to turntable

Canadian Industry at War



1 Canadian factories are going full tilt making war materials. Two operators weld magazine clips for Bren guns

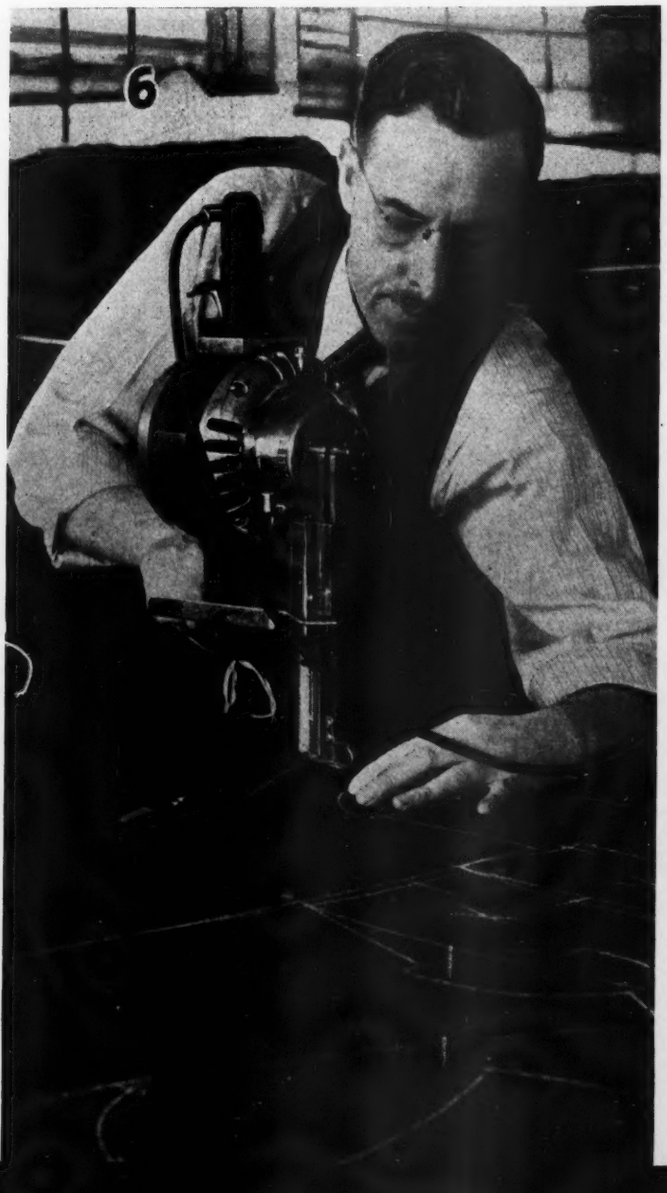
2 Women play an important part in Canadian war industries. These two are processing shell fuses

3 In a munitions plant, 40-mm. anti-aircraft shells receive a sprayed coating of waterproof lacquer

4 Shell inspection by the sharp eyes of this experienced worker is typical of many such careful inspections

5 Expert inspectors peer through finished gun barrels to detect even the smallest flaws in the bore

6 An expert cutter in a large clothing plant guides his cutting tool along chalked lines on army uniform material



7 A mechanic at work on undercarriage of a Handley-Page Hampden bomber provides a fair idea of this plane's size

8 Working on the framework of a Canadian-built Handley-Page Hampden bomber that may soon be dropping bombs

Simpler Work, So More for Defense

More bombers for national defense! Take a quick swing around the Martin plant. See how work simplification is helping 11,000 men catch the spirit of our defense effort. The fact is they work easier to do more work

LEWIS K. URQUHART
Associate Editor

A MAN who cuts duralumin tubing into short lengths used to walk two steps to get the material. Two more back to his machine. Another to deposit the cut-off lengths in a tote box.

Five steps—count 'em. All unnecessary. Not one of them adding a jot or tittle of value to the tubing.

Today the same operator takes no needless steps. Tubing is within easy reach. Finished lengths are drop-delivered to a conveniently placed tote box. More work, less fatigue.

Multiply the savings on this specific job by the dozens of cut-off operations in an aircraft factory. It will give a quick picture of the thousands—no, tens of thousands—of steps that are being saved daily because 300 men at the Glenn L. Martin Company plant in Baltimore have learned to think in terms of steps that don't have to be taken, motions that can be eliminated, jobs that can be made easier, fatigue that can be minimized, precious time that can be saved.

You Took a Walk

You had heard that Martin has been running a work simplification program since a year ago September. You are an American citizen. You had a letter from a vice-president. You had pried a pass loose from those whose job it is to see that passes are not pried loose. You had the blessing of the Army and the Navy.

You were on a personally conducted tour of a plant that only last month added a $99,000,000 contract to its $125,000,000 backlog of orders for both British and American planes. A plant that was already up to its neck in defense business. That was even then increasing its 1,260,000 square feet of floor space by 703,000 square feet. That added 10,000 men to its payrolls during the past twelvemonth. That must take on thousands more in months to come.

You began to see what it means to save five steps here, a few thousandths of a minute there. You made a few notes. You set them down as evidence of what work simplification had done for Martin, can do for any other plant where the principles are properly understood and properly applied. Your notes ran something like this:

1. A rivet pan is moved a foot or two closer to a man who drives 1,000 rivets per day. He saves six thousandths of a minute reaching for a rivet, six more carrying it to the machine. A trivial saving. But do a little easy multiplying. It comes to 12 minutes a day (1,000×0.012)—an hour a week—50 hours a year. A man can average 125 rivets an hour. In 50 hours, 6,250 rivets! *And there are hundreds of riveters in the Martin shops.*

2. Notches in a big, awkward shape—it's a rib frame—were formerly cut out by hand. Eighteen notches to a frame. Dozens of frames to a ship. Today the

OLD METHOD

Porthole cover assembly used to take 3 hours. Operator could have done quite nicely with a third hand. His left was about as useful to him as a good vise would have been

notches are cut on a notching shear developed from an air squeezer. *Saving in time, 51 percent.* And an extremely fatiguing operation eliminated.

3. In the inspection department, a man inspects bolts. On the bench before him he has several fixed go-no-go gages for length and a dial gage for diameter. Not too long ago this same inspector was measuring bolts with gages that called for awkward two-hand operation. His left hand was useful mainly as a holding device. His right was largely engaged in the useless occupation of picking up gages and laying them down again. *Today he can inspect four bolts in the time he used to take for one. A 300 percent increase in output.*

4. A storeroom has been moved to a better location. *Saving? Up to 10 miles of walking per day.*

5. Ring-shaped terminals are machine-clamped to short lengths of wire used for electrical connections. This job used to be done manually—with pliers. Today the operator feeds wire from one side, terminals from the other. Steel jaws do the clamping—better, of course, than it can be done by hand, and 68 percent faster. *Saving, on a single contract, over 900 man-hours!*

6. Parts for a certain assembly were spread over a 300-ft. range in one of the finished parts stockrooms. The boys in the room did a little rearranging, cut the range to 20 feet. *Savings in issuing time, close to 50 percent.*

7. Porthole cover assembly used to be a "three-handed" job. Took 3 hours. A simple wooden form has changed all that. Into the form the operator places 42 nuts. In another form he slaps a metal ring. Over the ring a disc of fabric. On top of that another ring. With an electric drill, he bores 42 holes, places the second form over the first slips in 42 bolts, tightens them with a

NEW METHOD

What a whale of a difference a simple wooden fixture can make! Operator now assembles porthole cover in a third of the time it used to take. See chart for details

PORTHOLE COVER ASSEMBLY

OLD METHOD

- Department stock rack
- Parts to workplace
- 1. Attach drill jig to reinforcing ring with 4 clamps
- 2. Place in vise
- 3. Drill 10 holes
- 4. Move drill jig to 2nd position
- 5. Drill 10 holes
- 6. Move drill jig to 3rd position
- 7. Drill 10 holes
- 8. Move drill jig to 4th position
- 9. Drill 12 holes
- 10. Remove ring from vise
- 11. Remove drill jig from ring
- 12. Attach drill jig to frame
- 13. Place in vise
- 14. Drill 10 holes
- 15. Move drill jig to 2nd position
- 16. Drill 10 holes
- 17. Move drill jig to 3rd position
- 18. Drill 10 holes
- 19. Move drill jig to 4th position
- 20. Drill 12 holes
- 21. Remove frame from vise
- 22. Remove drill jig from frame
- 23. Place frame in center of workplace
- 24. Place fabric over frame
- 25. Place ring over fabric
- 26. Stretch, center, and clamp fabric in 8 places
- 27. Punch 42 holes in fabric
- 28. Insert screw through assembly
- 29. Start nut on screw
- 30. Tighten bolt with hand screwdriver and wrench
- 31. Trim fabric

* (28–31)

- To stock rack
- *Repeat cycle 42 times

NEW METHOD

- Department stock rack
- Parts to workplace
- 1. Place 2 nuts in bottom fixture (2 at a time); repeat 21 times
- 2. Place frame in top fixture
- 3. Place fabric on pins in fixture
- 4. Place ring in drill jig
- 5. Place drill jig on fixture
- 6. Drill 42 holes through frame, ring, and fabric
- 7. Remove drill fixture
- 8. Remove ring from drill jig
- 9. Place ring in fixture
- 10. Place fixture over fixture which holds nuts
- 11. Insert screws (2 at a time); repeat 21 times
- 12. Tighten 42 bolts with air screwdriver
- 13. Remove assembly from fixture
- 14. Trim fabric
- To stock rack

SUMMARY			
	OLD	NEW	SAVINGS
No. of operations	31	14	17
Assembly time, Hours	3.0	1.1	63%

OLD METHOD. To turn a radius on a small grommet, operator had to open a clumsy vise, insert piece, close vise, lower drill by hand, raise drill, unscrew vise, remove piece by hand, brush away chips. Best he could do was three per minute

NEW METHOD. Simple two-movement vise handle opens and closes the block. Drill is lowered by a foot lever, one piece being held in hand while other is being machined. When the vise is snapped open, a blast of air (from small tube at left of drill) not only blows away chips but also blows piece into chute. Rate, 12 per minute

power screwdriver. Time, 1 hour. *Saving, 2 hours—67 per cent!* (For complete details see the accompanying process chart and before-and-after photographs).

8. To hold small parts together while being riveted, rubber wedges are used instead of holding screws, which had to be driven home by hand to hold the two pieces firm. These wedges are small right-angled triangles of rubber about an eighth of an inch thick. One leg is perhaps an inch long, the other a couple of inches long and forming a sharp angle with the hypotenuse. It is this sharp point that is inserted into the rivet holes and pulled through to hold the parts together. *Saving in time, on any one of dozens of jobs, in the neighborhood of 50 percent.*

9. On a motor rib assembly, it was formerly necessary to drive 42 screws to hold the pieces for riveting. A time-consuming operation. And, since the screws cut a thread in the rivet holes, the latter had to be redrilled before the rivets could go in. Today, no screws. Easy-acting spring skin clamps are inserted instead. They go in easily. Are just as easily removed. They cut no threads. *Through their use, the operator on this particular assembly has increased his output from 3 to 6 a day.* And the same gadget is used on dozens of other operations.

10. On still other assemblies, the rivets themselves are used instead of holding screws. Trick here is to keep the rivets from falling out before they are upset. Remedy is a little spring clamp with a hole in each end. Pressed together so that the holes line up, it is slipped over a rivet. Old method was to drill small holes for holding screws, place and drive screws. After drilling, the operator placed and upset rivets, one by one. After which he removed screws, re-drilled holes to rivet size, inserted and upset rivets. New method enables him to drill holes full size. He inserts rivets, holding them with clamps. Removes each clamp as he upsets the rivet. *Time saving, on any one of a dozen or more assemblies, up to 40 percent.*

11. In hull assembly, workbenches used to be located on the floor. There was a lot of running down and up—from scaffolding to floor and back again. It was almost elementary to make room for benches on scaffolding. *Saving? Hard to figure, but certainly hundreds of ups and downs in the course of a day's work.*

12. On a little machine in the drill-press department, the operator turns a radius on a small grommet—at the rate of 12 a minute. Used to do 3—with no less effort. Parts supply has been placed nearer—in a gravity-feed hopper. Quick-acting vise instead of old one with crank. Foot lever has replaced hand control. Air jet clears away metal chips—thus replacing hand brush—and at the same time blows finished part into chute leading to tote box. *Increase in output, exactly 300 percent.*

You were slightly groggy. Had heard that the aircraft business was "different"—learned that it wasn't. Discovered once more that the principles of work simplification could be applied in any plant no matter what the product.

It was good to flop into a comfort-

(*Continued on page 148*)

Can Your Plant Do Its Part in National Defense?
THIS CHART WILL HELP YOU CHECK

YOUR PLANT AND

MAKE THE PRESENT SUPPLY OF SKILLED WORKERS MORE EFFECTIVE

IMPROVE QUALITY OF SUPERVISION

1. Improve present foreman training courses, or set up new ones
2. Establish key-man appraisals or incentives

REVIEW AND CORRECT INDUSTRIAL RELATIONS POLICIES

1. Set fair wage rates through job evaluation
2. Provide for promotion on individual merit
3. Handle grievances promptly
4. Provide good working conditions

IMPROVE METHODS

1. Improve tool design
2. Install a suggestion system
3. Analyze methods by stopwat
   motion camera, etc., and s
   plify where profitable

GET THE MOST OUT OF PRESENT

PLAN PRODUCTION

1. Have enough work on hand to keep operators and shift busy at all times
2. Run larger production lots, where practical, in order to minimize set-up costs

INVESTIGATE MACHINE SPEEDS

1. Get rated maximum speed from the manufacturer
2. Overhaul machines so they can be run at rated maximum speed
3. Install anti-friction bearings at vital spots
4. Observe effect of new speeds on quality of product

SIMPLIFY OR MECHANIZ HAND OPERATIONS

1. Apply motion analysis; use (
   process charts, (b) stopwat
   (c) motion camera
2. Design and build (or buy) n
   tools, jigs, and fixtures
3. Design and build (or buy) n
   attachments

MAKE THE BEST POSSIBLE USE OF PRESENT MATERIALS

STANDARDIZE MATERIAL SPECIFICATIONS

1. Select, through joint action, the material specification that insures uniform quality and satisfactory product, balanced with low labor and low material costs

STANDARDIZE INSPECTION AND TESTING PROCEDURES

1. Subject incoming materials to standard physical, chemical, and visual inspections to insure their meeting standard specifications

INSTALL SOUND WASTE AN SPOILAGE INCENTIVES

1. Determine maximum unavoidab
   waste through analysis of pa
   records and time studies
2. Set up bonus plan for waste
   scrap saved

ND THE NATIONAL PROD

MEN

How Can Your Plant Get the Skilled Workers It Need

F SKILLED VE

METHODS

esign
stion system
ds by stopwatch,
ra, etc., and sim-
rofitable

IMPROVE PLANT LAYOUT AND MECHANIZE HANDLING

1. Make flow charts
2. Analyze handling methods (use time study if necessary)
3. Simplify layout, conveyorizing where profitable

DEVELOP OR PURCHASE NEW LABOR-SAVING MACHINERY

1. Investigate production and quality possibilities of new machinery and equipment
2. Compare unit costs on old and new machines, including labor, material, burden, amortization

REVIEW WAGE INC — INSTALL INCEN WHERE NOT IN

1. Study and improve m stopwatch or motio
2. Set fair standards from ies of improved meth
3. Set up an adequate wage incentive plan

MACHINES

What Course Should Your Plant Follow in Expanding Its Plants an

F PRESENT EQUIPMENT

MECHANIZE ERATIONS

analysis; use (a)
, (b) stopwatch,
mera
ld (or buy) new
fixtures
d (or buy) new

INSTALL PREVENTIVE MAINTENANCE PROGRAM

1. Set up maintenance records to show life of equipment, frequency of breakdown, etc.
2. Provide for periodic inspection
3. Replace worn parts, as indicated by inspection

OPERATE MULTIPLE SHIFTS

1. Spread supervisory force to make it most effective
2. Hire new help
3. Plan and schedule work for a minimum of idle time

MATERIALS

How Can Your Plant Be Sure It Will Have Ample Stocks of Ma

OF

WASTE AND NCENTIVES

um unavoidable
analysis of past
ne studies
an for waste or

REDESIGN PRODUCT FOR LOWER WEIGHT AND HIGHER STRENGTH

1. Improve structural design to lighten part, increase its strength, and improve its appearance

RUN TESTS ON ALL POSSIBLE SUBSTITUTES

1. Determine which domestic materials are suitable
2. Determine probability in a national emergency of getting such materials in adequate quantity

Prepared for **FACTORY MANAGEMENT and MAINTENANCE** by R. H. Rositzke, R. H

E NATIONAL PRODUCTION

MEN

How Can Your Plant Get the Skilled Workers It Needs?

OVE PLANT LAYOUT ND MECHANIZE HANDLING

e flow charts
yze handling methods (use e study if necessary)
lify layout, conveyorizing ere profitable

DEVELOP OR PURCHASE NEW LABOR-SAVING MACHINERY

1. Investigate production and quality possibilities of new machinery and equipment
2. Compare unit costs on old and new machines, including labor, material, burden, amortization

REVIEW WAGE INCENTIVES — INSTALL INCENTIVES WHERE NOT IN USE

1. Study and improve methods (by stopwatch or motion camera)
2. Set fair standards from time studies of improved method
3. Set up an adequate and fair wage incentive plan

REVIEW WASTE AND SPOILAGE STANDARDS

1. Determine minimum unavoidable waste through analysis of past records and time studies
2. Set up incentive plan for waste and scrap saved

MACHINES

What Course Should Your Plant Follow in Expanding Its Plants and Equipment?

T

CONSIDER POSSIBI NEW BUILDINGS AN

STALL PREVENTIVE NTENANCE PROGRAM

up maintenance records to ow life of equipment, fre- ency of breakdown, etc.
ide for periodic inspection lace worn parts, as indicated inspection

OPERATE MULTIPLE SHIFTS

1. Spread supervisory force to make it most effective
2. Hire new help
3. Plan and schedule work for a minimum of idle time

DETERMINE WAYS TO INCREASE PRODUCTION

1. Prepare flow sheets; determine whether elimination of bottlenecks is sufficient or whether duplicate buildings and equipment are needed
2. Determine how much increase in production each proposed change will provide

CONSIDER TIM TO GET NE INTO PRO

1. Get delivery da tion dates fro and contracto
2. Determine when start
3. If time is too lo to write off e

MATERIALS

How Can Your Plant Be Sure It Will Have Ample Stocks of Materials?

USE NEW OR A

ESIGN PRODUCT FOR OWER WEIGHT AND HIGHER STRENGTH

prove structural design to lighten part, increase its strength, nd improve its appearance

RUN TESTS ON ALL POSSIBLE SUBSTITUTES

1. Determine which domestic materials are suitable
2. Determine probability in a national emergency of getting such materials in adequate quantity

NOTE EFFECT OF NEW MATERIALS ON FABRICATING COSTS

1. Determine new equipment needed or changes in present equipment
2. Determine effect on labor costs
3. Obtain material prices, current and probable
4. Determine effect on prices

NOTE EFF NEW MATERIALS USEFULNESS, APPEARANCE

1. Make tests to substitutes mos the finished pr istics of the

r **FACTORY MANAGEMENT and MAINTENANCE** by R. H. Rositzke, R. H. Rositzke & Associates, New York, N. Y.

Every plant, whether directly engaged in the manufacture of defense matériel or not, is bound in the present emergency to do all it can to increase the national production. This check chart is designed to help you test your plant's preparedness

INCREASE THE SUPPLY OF SKILLED WORKERS

ESTABLISH PROMOTION POLICY

1. Promote along the line wherever possible
2. Make a practice of hiring employees in lower-skill brackets, moving them up the line
3. Develop promotion sequences (this may come as a logical byproduct of job evaluation)

DECREASE TRAINING TIME WHERE POSSIBLE

1. Establish company training plan designed to turn out operators in shortest possible time
2. Cooperate with community trade schools; supply equipment and instructors

SPEED UP APPRENTICE TRAINING

1. Organize and intensify training course
2. Select apprentices with care; examine and improve employee selection methods

CONSIDER POSSIBILITIES OFFERED BY NEW LAYOUT

PREPARE FLOW SHEETS — CHECK POSSIBILITIES MORE PRODUCTION EXISTING EQUIPMENT

1. Include time cycles and labor in flow sheet of present layout
2. Redesign layout for higher production, less floor space, and lower labor cost

WEIGH NET EFFECT ON UNIT COSTS, USING SHORT-TERM AMORTIZATION

1. Compute comparative unit costs, including labor, materials, and burden
2. Include in burden a quick write-off of new buildings, machines, and handling equipment

REVIEW PURCHASING POLICIES

ORDER FEWER SIZES AND VARIETIES OF MATERIALS

1. Incorporate purchasing plan with program of standardization of materials, methods, processes
2. Get price benefits of large-quantity buying

KEEP SEVERAL SUPPLY SOURCES OPEN

1. Don't depend on one supplier
2. Place token orders regularly, even at higher prices, so that other suppliers will be able to meet specifications

Every Week the Same Pay Check

A small plant proves that stabilization of employment and worker income, with adjustments for varying cost of living, can be worked out despite wide swings in sales

WILLIAM C. TREUHAFT

President, The Tremco Manufacturing Company, Cleveland

Mr. Treuhaft was born in Cleveland in 1892. After completing studies at Western Reserve University and Case School of Applied Science, he entered the employ of Sterling Products Company, wholesale jobbers of maintenance materials, becoming its president in time. Shortly after that organization entered a merger and went out of existence, Mr. Treuhaft founded Tremco and its Canadian affiliate, Tremco Manufacturing Company (Canada) Limited. That was in 1928. During the World War he served in the U. S. Naval Reserve, Naval Aviation Division, as an inspector of airplane construction. A large part of his time during all his life has been devoted to social welfare interests, and he has served as trustee of several welfare institutions. Hobbies are gardening, horseback riding, and sailing, particularly sailing, to which he devotes all the time he can snatch from business cares

EVERY ONE OF THE MEN, skilled and unskilled, who are employed in our factory knows that he will receive 52 weekly pay checks a year. None of these checks will be for less than forty times the worker's hourly rate. For reasons to be explained later the June 1 check may be larger than the others. A guaranteed income, such as our men have, permits them to budget their expenses and manage their affairs with confidence.

This payment plan was installed two years ago, and employees and management alike are convinced that it is thoroughly desirable and sound.

Putting this plan into operation was not altogether easy because of certain characteristics of our business. Whether the fact that we have only a small number of factory employees was a hindrance or a help, might be open to question. There is no doubt that the seasonal demand for our products made the problem much more difficult.

Volume Varies 45 Percent

Our products—paint, waterproofing compounds, and other materials—are used in building construction and maintenance. Experience shows that during a year there are approximately four months in which business may be termed normal. These months are April, May, October, and November. During December, January, February, and March business is slack. On the other hand in June, July, August, and September the demand for our products is above normal.

Our records show that, roughly, the amount by which the volume of business falls below the normal level in the slack period is somewhat more than 25 percent. They also show that the amount by which the normal volume is exceeded in the peak period is approximately 20 percent. Variation between the high and low levels is therefore about 45 percent.

We had also to take into account the fact that the selling prices of the kinds of building materials we make are relatively stable and show little change over considerable periods.

It is highly desirable, of course, to give continuous year-round employment with full-time pay to all regular employees. It is clear, however, that if we employed regularly the number of workers who would be required in order to operate the plant during the peak period, we should be obliged to make work for, or lay off, 20 percent of this number for approximately eight months of the year. In addition, about one-fourth of the remainder of the regularly employed workers would have to be laid off or taken care of in some way during the four months of the slack period. In the long run, as our organization grows in size, regular employment of the full number of men who would be required to operate the plant during the peak periods would be certain to mean shorter hours and smaller pay checks for all employees during the slack seasons.

With all these factors in mind the payment plan now in operation was worked out. We are confident it will eventually result in a higher annual rate of earnings for all factory workers.

On the basis of a 40-hour week there are 2,080 working hours in the year, provided a worker takes no vacation and loses no time on account of sickness or for other reasons.

We guarantee all regularly employed workers who have been with us for twelve full consecutive months 52 weeks' pay at rates determined by mutual agreement. Each weekly pay check is estimated at 1/52 of the annual pay. Vacations with pay limit the actual working time to a total of 2,000 hours in any one year, in accordance with the provisions of the Fair Labor Standards Act of 1938.

It is our intention to employ regularly in the Cleveland factory only the number of workers required to operate it on the basis of a 40-hour week during the period of normal business volume; that is, during April, May, October, and November. For the 17 weeks of peak production from June to September, inclusive, the regular work week may be increased to 47½ hours or 5 days of 9½ hours each. During this period, however, each worker receives his regular rate of pay for 40 hours, and the pay for the extra 7½ hours is placed to his individual credit in what we term an Employees' Pay Reserve Fund.

In the 17 weeks of the slack period—December to March inclusive—the regu-

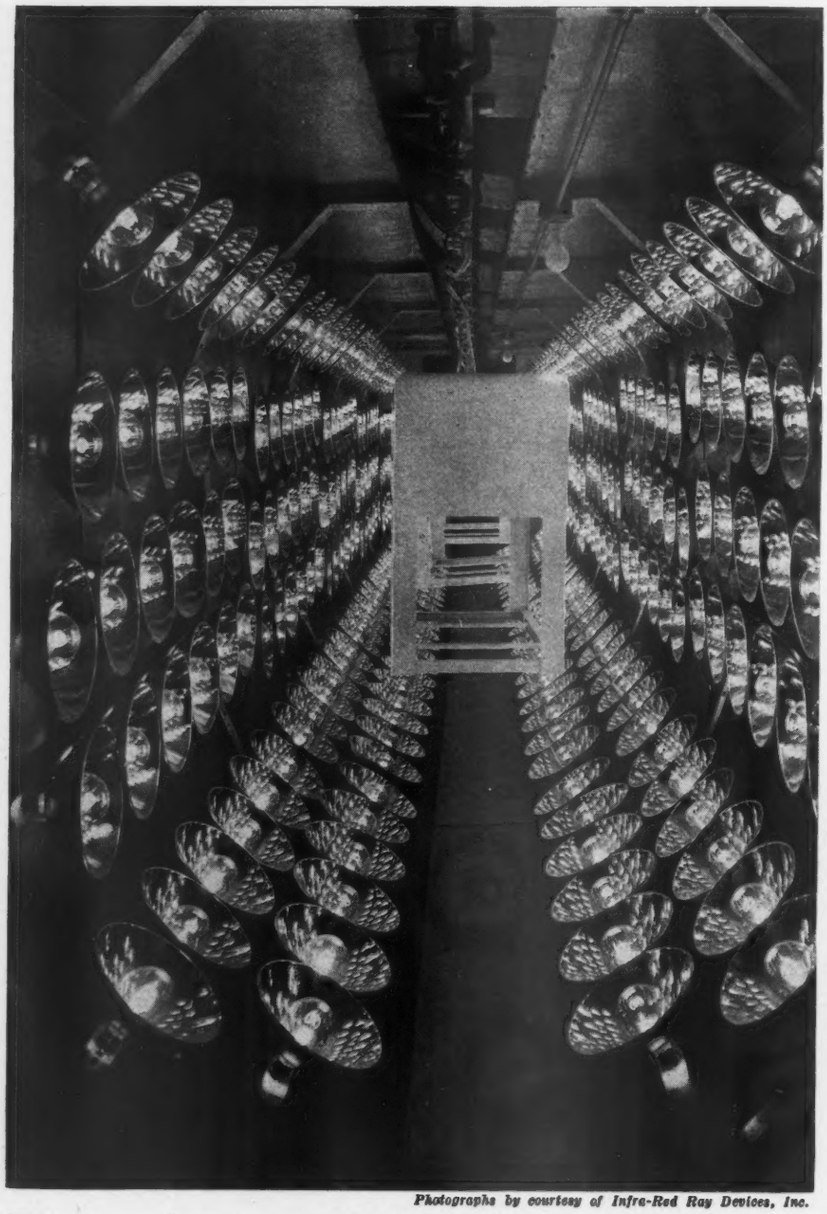
(Continued on page 144)

For Us, Infra-Red Drying

Three reasons: (1) Equipment costs less to install, less to run, than other kinds; (2) takes one-third the space; (3) can be moved in and out of production lines at will

CHARLES H. NEWTON

Superintendent
Lonergan Manufacturing Company
Albion, Mich.



Photographs by courtesy of Infra-Red Ray Devices, Inc.

Within the oven lamps are arranged in banks of six lamps each. These banks are staggered to give more even and efficient heat distribution and thereby save power

LAST AUGUST, when a large order of beverage cooler cabinets was under consideration, we intended to use oven capacity already available on our space heater line for paint drying. Design changes delayed the start of this new product, however, until after the beginning of the space heater season, and then additional facilities had to be provided.

This brought a new factor into the picture, that of investment cost, and, of course, the time needed to install the equipment whatever it was to be.

Inquiries disclosed that infra-red drying lamps had been successfully used on the kind of job we had to do—drying primer and enamel coats on 14- and 20-gage sheet steel cabinets. The cost of the necessary drying equipment was found to be about half that of any other combination. The drying and baking temperature is 470 degrees and the cabinets require 5 minutes in this heat. We found, also, that an infra-red installation would require only about one-third the space ordinarily required, and that the drying oven, consequently, could be placed on the manufacturing floor in the regular sequence of operations, rather than on the roof as otherwise would be necessary due to space limitations.

Installed in Six Weeks

Since no motors, controls, fans, nor tanks were required, installation was short, which was a big advantage in our case because the design changes had shortened the delivery date materially. As a matter of fact, only six weeks were required to set up the complete sequence of clean, rustproof, dehydrate, spray, bake primer and enamel coat, and letter. This was done during the time that the dies and tools for the sheet metal operations were being made. Two hundred cabinets per day are run through this process. The extremes in the four sizes of cabinets are 25x52x31 inches and 20x36x31 inches, and as sheet metal and angle iron are used in the product, varying drying requirements are therefore met. In fact, a design change after the drying oven was set up added a 14-gage metal framework to the bottom of the cabinets; this, however, was met by the addition of a row of lights on each side of the oven catwalk, demonstrating the flexibility inherent in this equipment.

The photographs show the sequence of operations following the sheet metal

forming and welding. The cabinets are cleaned, rustproofed, and dehydrated before moving by overhead conveyor to the adjacent spray booths. The dehydrating is done by infra-red, and it is the last job before the cabinets are hung on the conveyor for the spray booths. Two large cabinets and three small ones are dried at the same time. Thirty 10¼-in.-diam., 24-carat-gold-washed reflectors, on two sides of this pit, are sufficient to dry the cabinets within the time required by the cycle.

Following the spraying of the primer coat, the work continues on the same conveyor through the infra-red heating tunnel. There are 360 lights arranged in 12 rows in the 30-ft.-long oven. Special carbon-filament heaters in 10¼-in. gold-washed reflectors are used. A series of six lights is attached to a bar containing the sockets and asbestos-covered wire; six of these bars are controlled by one switch, so that a section of one side of the oven is thrown on with one turn of the switch arm.

It will be noted that three rows on each side of the oven are staggered. This gives a wash action in the drying, for the work is not always in the same focal point, and local overheating is consequently avoided. This, incidentally, is the first installation of infra-red which embodies this principle; it not only gives a better heat distribution, but the kilowatt-hour consumption is considerably less.

Soda Dip Cleans Reflectors

The gold-washed reflectors give carrying power to the infra-red rays of the carbon heaters, since they are highly efficient. This has a maintenance angle, for the radiant energy is thrown upon the work and is not absorbed by the fixtures to constitute a problem in wire insulation breakdown; nor is insulation needed on the oven sides. A caustic soda dip, and the reflectors are as good as new.

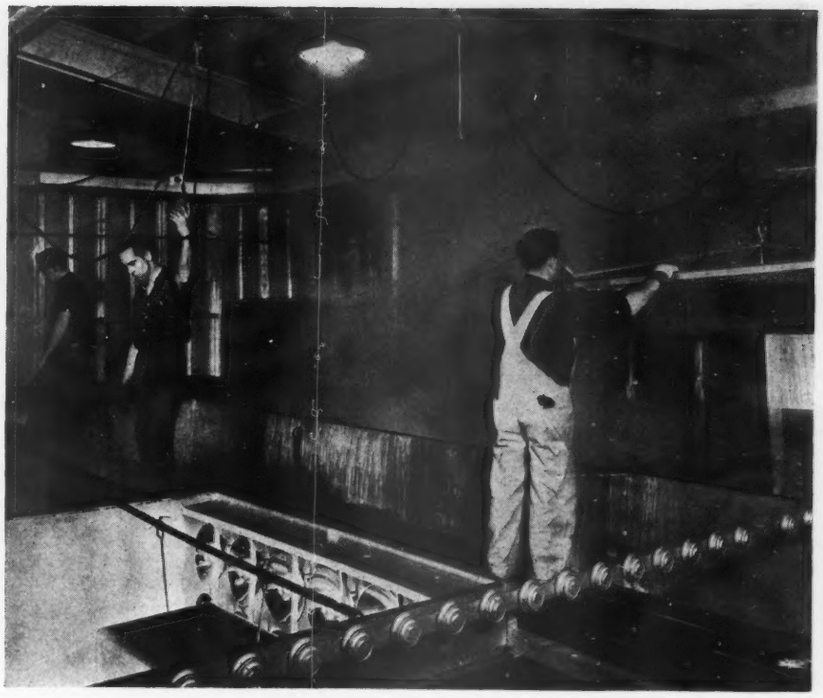
A lead from the transformer bank was brought over to the oven and the switch connection made for each section of 36 lights. With filament lamps, of course, the power factor is 100 percent.

After a passage through the tunnel to dry the primer coat, the cabinets continue on the same conveyor back through the spray booths for the enamel coat, and again through the tunnel.

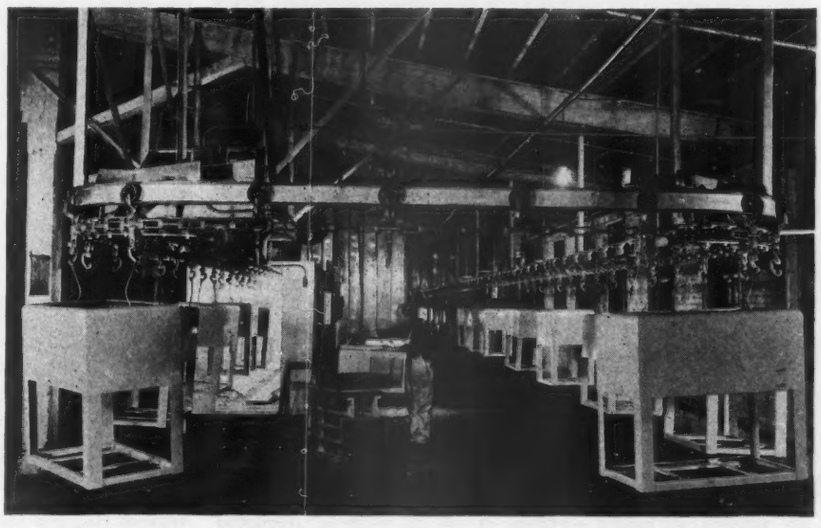
At this point, there is an interesting example of the flexibility possible with this drying equipment. Lettering, or embossing of descriptive material, is necessary on three sides of these cabinets. Two men take the dried enamel-coated cabinets off the overhead conveyor and perform this silk screen operation on a special jig. Drying is then necessary. But, instead of another passage through the oven, a floor unit having a bank of infra-red lights on three sides is provided. A fixed back is attached to a roller conveyor placed on the floor; to each end of this fixed back are hinged a second and third bank of lights. One end is swung open when a lettered cabinet is to be rolled into position for baking the lettering, and the opposite end is swung open when the finished cabinet is to be sent on to the crating department. The fixed back section is 3x6 feet and each hinged end 3x3 feet. The main baking tunnel is 5x33 feet and the overall space required for the operations described here is 40x150 feet.

Several advantages offered by this installation have been suggested, but others need to be mentioned. The process of baking involves no delay to get up to heat; turn the switches and the tunnel is ready to function immediately. This is of marked value in small or intermittent production, for no wait is involved and no heat (power) is

(*Continued on page 136*)



Thirty infra-red lamps in the dehydrating unit dry cabinets preparatory to painting



Cabinets leaving the heating oven. Some are ready for embossing, some must go back by conveyor for their enamel coat, after which they pass through the oven again

Wrote "Finis" to Lead Poisoning

Defense work will plunge many a plant into unfamiliar operations. Look out for lead poisoning, warns Briggs, and tells how it spent $500,000 to control this hazard

H. J. ROESCH
Director of Industrial Relations
Briggs Manufacturing Company, Detroit

NOT A CASE of lead poisoning in more than 3 years! That's our record—in a plant where, only a few years before, lead dust constituted a very serious occupational hazard. To lick it we spent upwards of $500,000. And it was 18 months before everything was under control.

Ordinarily we are not given to tooting our own horn. In fact we should be inclined to save our breath this time if we didn't think that by telling our story we might be able to help other plants who are facing—or will be facing—the same difficulties we faced. I say "will be facing" because, as the defense program gets into full swing, many industrial concerns will be plunging into new (to them) metal-working operations that may lead them unwittingly into the very same situation in which we found ourselves a half-dozen years ago.

With us as well as the other auto body manufacturers it was all due to a change in design. The automobile industry at that time was shifting from the composite body of metal and wood to the all-metal body now in universal use. The fabrication of the new all-metal body involved a lot of welding. Welding meant soldering to fill up joints and seams. And solder and weld marks had to be removed in order to get smooth surfaces. Their removal caused the formation of lead dust. And there we were with a lead poisoning hazard on our hands.

First we knew of it was when a couple of men came down sick. Our initial move was to call in the experts —one an independent consultant who had long experience in combating occupational diseases, the other the chemical engineer of our insurance carrier, whose entire time is devoted to

No grinding on solder surfaces except in properly ventilated booth with approved grinder. It's aluminum, wets dust as it is generated. Men in affected areas must wear respirator

Vacuum cleaners are used constantly during production hours to remove harmful dusts as soon as possible after they have been generated. Each man gets a clean respirator each day

the study of occupational hazards the country over. We also got splendid co-operation from the Bureau of Industrial Hygiene of the Detroit Department of Health and from the State Department of Labor and Industry.

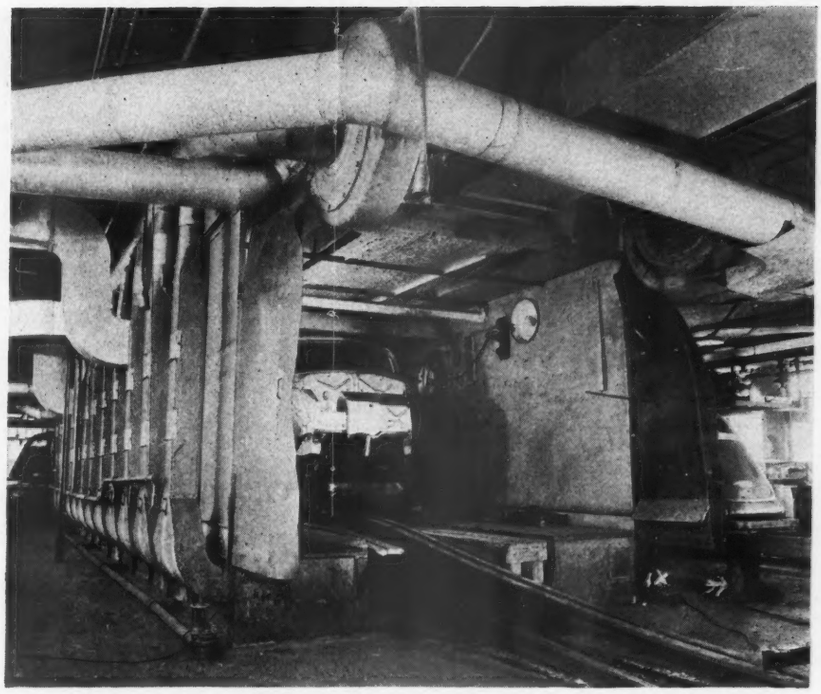
Out of this preliminary discussion came an attack on lead dust that was designed to:

1. Prevent men from breathing dust.
2. Enforce strict hygienic rules.
3. Remove dust at source.

To prevent the breathing of dust, men in the affected departments were equipped with two respirators apiece and required to wear one at all times. Careful tests were made to determine the efficiency of these respirators in

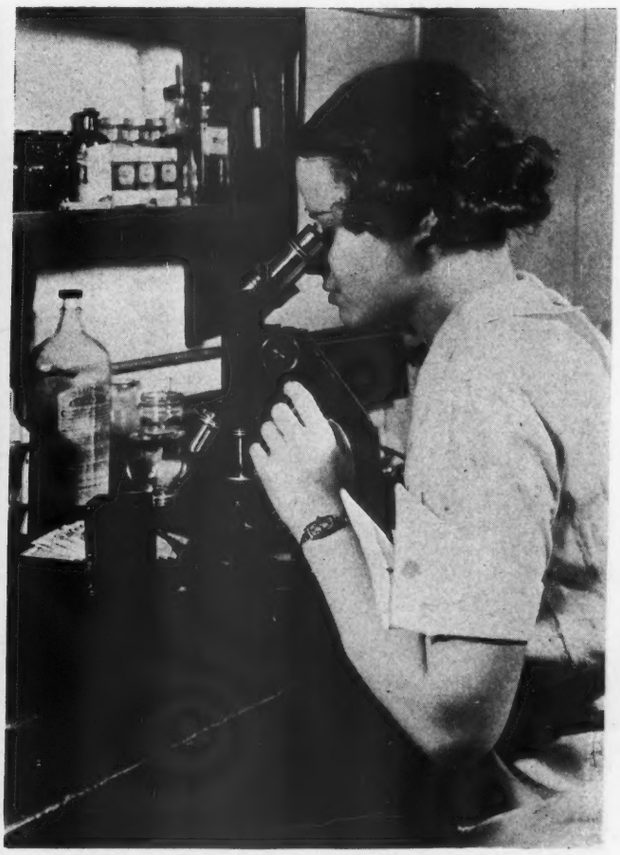
THE AUTHOR

Served his apprenticeship as machinist and toolmaker. Was assistant state supervisor of apprenticeship training for the State of Wisconsin, 1919–1923. Also director of industrial education for a large metal manufacturers' association. Has been director of industrial relations at Briggs for the past 8 years



Push-pull ventilation makes this grinding booth a safe one to work in. A current of air moves down from ceiling ducts and out through slat-covered floor ducts. Men must wear respirators, are allowed to use only an approved wet grinder on solder surfaces

Central cleaning system has numerous conveniently spaced floor outlets hooked up by vacuum lines to large storage tanks. Dust is washed out before the air is exhausted to outside atmosphere



Blood studies are carried on unceasingly. Every man in the affected areas has his blood checked every month. Here one of laboratory technicians examines a sample under the microscope

Special washroom with lunch tables was set up for the exclusive use of those in lead-affected areas. Men were required to wash hands, face, neck, and ears before eating. Company provided brushes, soap, towels. Eating in departments strictly prohibited

On finishing lines, fresh air is "pushed" down over bodies and "pulled" through slat-covered ducts on the floor, thus forms protecting curtain of air between man and work

eliminating dust. Two were provided so that one could be cleaned and sterilized while the other was being worn. Respirators were cleaned at the end of each day's production with compressed air and sterilizing fluids. They were then placed in paper bags so that no one might touch them or any dust reach them until the operator took his respirator out of the bag and put it back in use.

All this was relatively easy. One can buy respirators without too much difficulty and see to it that men wear them. It is more difficult to enforce strict hygienic rules. But it *can* be done.

We did it by setting up a special washroom for the exclusive use of men in lead-affected departments. Men were required to wash hands, face, neck, and ears before eating. Foremen were assigned to see to it that these rules were obeyed. The company provided brushes, soap, and towels. Eating in the departments was strictly prohibited.

Biggest part of the job, however, and the one that involved most of the $500,000 expenditure, was removing the dust at the source.

Since all dust eventually settles on floors and ledges, the obvious thing to do was buy vacuum cleaners. We installed two kinds—the portable type and the kind that is hooked up through a series of vacuum lines in floors and

(*Continued on page 152*)

Wagner Act Quiz

If national defense is not to stall anywhere along the line, supervisors must know the essentials of the Labor Law. To help them, especially the thousands who will step into supervisory jobs in coming months, *Factory* offers this "true or false" quiz

JOSEPH TIFFIN

Division of Education and Applied Psychology, Purdue University

DIRECTIONS: The following statements are either true or false. You are to answer the statements by drawing a circle around the *T* if you consider the statement to be true, or around the *F* if you consider the statement to be false. *Do not guess.*

Example: The National Labor Relations Act (NLRA) of 1935 is often called the Wagner Act. (T) F

For key to correct answers see page 150.

1. You can fire a union man for breaking the rules so long as you can prove that company rules are enforced fairly and in the same way for all workers. T F

2. The employer is held responsible for a foreman's or supervisor's statements or actions whether or not the company officials know about it in advance or approve of it afterwards. T F

3. The law states that you must give an opinion if asked what you think of a union. A refusal to answer is considered a misdemeanor. T F

4. Collective bargaining involves negotiations in good faith by the employer and always requires that an agreement be reached. T F

5. A company foreman or supervisor always speaks as a representative of management (never on his "own") when he says or does anything about the union connections of his employees. T F

6. When workers go out on strike but not in protest against a violation of the NLRA, their employer is required to continue to bargain with representatives of the employees, but is not obligated to take back anyone so long as he does not discriminate against a particular worker or group of workers. T F

7. The employer may use special workers to report union activities and membership. T F

8. The minority group of employees who do not wish to be represented by the majority spokesman, enjoy the same rights as the majority group. T F

9. In the preliminary conference, even if the charges are answered satisfactorily by the employer so that the Field Examiner is of the opinion that no violation of the National Labor Relations Act exists, the Field Examiner is empowered to suggest to the complainant that his charges be withdrawn. T F

10. You can discipline or discharge an inefficient employee, regardless of whether or not he holds membership in a union. T F

11. Employees may be summoned to the company office for the purpose of asking whether they approve of, or belong to, a union. T F

12. It is not illegal to try to induce individual strikers to return to work instead of negotiating with the strike leaders. T F

13. Union members may be laid off as well as any other workers so long as those dropped are selected either on the basis of their lack of seniority or low rating on efficiency. T F

14. An employer may refuse to bargain collectively with the representatives of his employees. T F

15. A foreman may ordinarily belong to some form of union if he so desires, but he should not take an active part in behalf of or against the organization. T F

16. A formal complaint is issued by a Regional Director of the National Labor Relations Board (NLRB) to an employer before the preliminary conference between a regional representative and the employer. T F

17. Available jobs should be filled on a basis of experience and ability of the applicants without regard to membership or nonmembership in a labor organization. T F

18. The foreman may legally show favoritism towards workers who belong to a labor organization. T F

19. Foremen may influence workmen to join an independent union but not one that is affiliated with a national labor organization. T F

20. Management can refuse to hire new workers or former employees for vacant jobs because of their past or present union connections. T F

21. In some industries hiring of men must be done only through business agents of the union. T F

22. Only about one case in twenty that comes up under the NLRA ever reaches the stage of formal complaint. T F

23. A company can refuse to hire a new man merely because he belongs to a union. T F

24. Foremen who work in behalf of a union are considered to be violating the NLRA just as much as if they had shown a dislike for the organization. T F

25. The employer does not have the right to request the NLRB to certify the collective bargaining group with which he should deal. T F

26. Employees who are guilty of insubordination cannot be fired in order to maintain discipline in the plant. T F

27. An employer who does not know which of two or more competing unions he should bargain with, may under certain

(*Continued on page 139*)

Management Shorts

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary management accomplishments. Accepted articles will be paid for

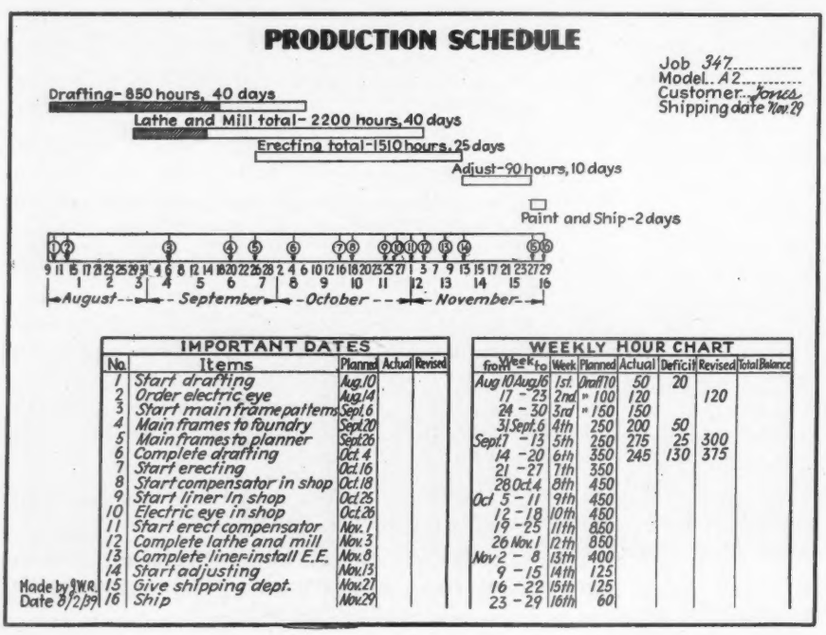
PRODUCTION PLANNING AND CONTROL

A Small Plant Can Have Production Control, Too

JOHN W. ROBINSON
Potdevin Machine Company
Brooklyn, N. Y.

The small-plant man errs in believing that he cannot have adequate production control because the cost of such control is prohibitive. In our machine shop, employing 100 men, I am able to coordinate production by devoting only a few hours a week to the task. A very simple chart helps me keep things straight.

One of these charts is provided for each job. It shows the number of hours required each week, starting and completion dates of the main operations, sending and return dates of outside work. By looking at it the superintendent can see at a glance the job's progress. For instance, the chart indicates that on September 20 lathe and mill work is behind four days, and drafting two days. Discovering this, the superintendent goes after the cause of the delay, and revises schedules to bring the order up to date.


PRODUCTION SCHEDULE
Job 347
Model.. A2
Customer.. Jones
Shipping date Nov 29
Drafting - 850 hours, 40 days
Lathe and Mill total - 2200 hours, 40 days
Erecting total - 1510 hours, 25 days
Adjust - 90 hours, 10 days
Paint and Ship - 2 days
August
September
October
November
IMPORTANT DATES
No. Items Planned Actual Revised
1 Start drafting Aug. 10
2 Order electric eye Aug. 14
3 Start main frame pattern Sept. 6
4 Main frames to foundry Sept. 20
5 Main frames to planner Sept. 26
6 Complete drafting Oct. 4
7 Start erecting Oct. 16
8 Start compensator in shop Oct. 18
9 Start liner in shop Oct. 25
10 Electric eye in shop Oct. 26
11 Start erect compensator Nov. 1
12 Complete lathe and mill Nov. 3
13 Complete liner-install E.E. Nov. 8
14 Start adjusting Nov. 13
15 Give shipping dept. Nov. 27
16 Ship Nov. 29
Made by SWR
Date 8/2/39
WEEKLY HOUR CHART
From Week to Week Planned Actual Deficit Revised Total Balance
Aug 10 Aug 16 1st Draft 10 50 20
17 - 23 2nd " 100 120 120
24 - 30 3rd " 150 150
31 Sept. 6 4th 250 200 50
Sept. 7 - 13 5th 250 275 25 300
14 - 20 6th 350 245 130 375
21 - 27 7th 350
28 Oct. 4 8th 450
Oct 5 - 11 9th 450
12 - 18 10th 450
19 - 25 11th 850
26 Nov. 1 12th 850
Nov 2 - 8 13th 400
9 - 15 14th 125
16 - 22 15th 125
23 - 29 16th 60

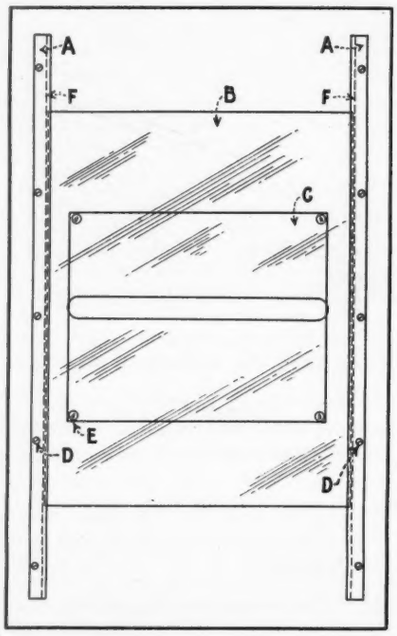
•

Transparent, Slotted Cover Keeps Shop Records Clean

JOHN E. HYLER, *Peoria, Ill.*

As a general rule, it is not practical for the foreman finisher who spends part of his time with a spray gun to clean his hands each time he makes a notation on a record. Unless he does, however, the records will soon show such an accumulation of paint and dirt as to make them untidy, if not actually worthless.

The sketch shows a device that may be used to advantage for allowing continual access to a record sheet, both for obtaining data and for making necessary additions as the work proceeds, and yet protecting it from dirt. This holder



can be mounted on a desk or bench top.

Two light pieces *A*, which may be either strips of sheet metal with an offset bent in them or two strips of hardwood with a small rabbet cut in the under side (as indicated by the dotted lines), are screwed down in parallel to form a slideway for a rectangle, *B*, of transparent plastic material. The slideway is made enough wider than the paper on which the record is to be kept, to allow a slot to be cut through the transparent plastic the full width of the paper, and to leave sufficient material standing at the edges so that *B* will not be unduly weakened. The record sheet *C* is then simply thumbtacked with four tacks *E* in the center of the slideway. Enough screws *D* must be used to insure that *A* will be held tightly to the desk top, to prevent the edges of *B* from fouling under the rabbet corners *F* at any point.

The record sheet is legible under the transparent protective material at all times, and there is sufficient cover both above and below the slot in sheet *B* to cover the record sheet fully. To

CARELESSNESS !
AND PREVENTABLE WASTE!
COST US THOUSANDS
OF $ ANNUALLY
WILL YOU HELP PREVENT
EXAMPLES SUCH AS THESE
STOP!
AND
PICK IT UP!
If it's worth making it's worth saving
PREVENT WASTE
HOW AND WHERE TO CUT WASTE
HOW and WHERE TIME IS WASTED
HOW and WHERE Materials and Supplies Are WASTED
HOW and WHERE Machinery & Equipment Are WASTED
How and Where Electric Current, Steam, Compressed Air, Water, Heat and Gas are WASTED
The WASTE & COST of ACCIDENTS
HOW and WHERE SPACE is WASTED
Sep Assembly Department Waste
Fastener Engrg Department Waste
Chain Machine Department Waste
Reg Assembly Department Waste
Sep Assembly Department
Reg Assembly Department
Good Top Studs Sent To Be Stripped
C And R
Good Top Studs Sent To Be Re-Assorted
C And R

Salvage display used by Talon, Inc., in successful waste-prevention campaign conducted at its Meadville and Erie, Pa., plants

make an entry on the sheet, the transparent cover is simply slid along until the slot falls over the portion of the record sheet to be written on. Any dirty deposit is automatically received on *B* instead of *C*, and *B* may be washed clean at any time.

•

New Timekeeping Procedure Saves $3,000 a Year

ALFRED ROBBINS, *Plant Engineer*
Burndy Engineering Company, Inc.
New York

A simple timekeeping procedure was recently installed in one department of our machine shop, which will save approximately $3,000 annually in direct labor costs.

It had been customary for the operator to bring his work ticket to the timekeeper, who was located at a central point in the shop, for punching out on the completed job and in on his next job. It was also necessary for the timekeeper to write in certain essential data such as operation number, operator number, and number of pieces completed. This caused frequent lineups at the timekeeper's desk while operators waited to have their cards punched.

An average of three minutes of the operator's productive time was lost for every change of job. Since the 75 men in this department work on from 5 to 20 different jobs a day, it can be readily seen that the accumulated lost time reached a sizable figure.

To alleviate this condition, several steps were taken. First, a buzzer system was installed, using a 75-station annunciator which was set up at a central point in the shop. Second, a pushbutton was placed at each work station, within easy reach of the operator. Third, two time clocks were placed at two easy-to-reach points in the department.

The new procedure is as follows: When an operator finishes his first job, he presses the buzzer button, informing the timekeeper of this fact, and immediately starts work on his next assignment. When the timekeeper receives the signal on his annunciator board, he goes to the designated work station, fills in

the necessary data on the completed job card, takes the card to the nearest time-clock, and punches the job out. The new job ticket is punched in at the same time so that no second trip is needed.

This procedure has cut lost time to a minimum. It has resulted in a more orderly appearance since the movement of men around the shop has become almost negligible.

HANDLING AND MOTION ECONOMY

Overhead Basket Carrier Brings Parts from Stockroom

SOURCE

Zenith Radio Corporation, Chicago

Often it is possible to reduce leg-work by employing some form of mechanical handling, and by the same change save time by reducing opportunities for non-productive sociability.

Our service department repairs radio sets, most of them obsolete models. With only a few men employed in this department, it is obviously not worth while to maintain a stock of obsolete parts in the department. Therefore, the parts have to come from the obsolete parts stockroom maintained for shipping obsolete parts to dealers.

This stockroom was intentionally located rather close to the service department. But whenever a service man needed a part he made out a requisition, then walked across the aisle and stood at the window waiting while the stockman got the part. Human nature being what it is, the contacts were prolonged from time to time by a little friendly visiting.

Installation of a simple overhead basket carrier, of the old-time department-store type, neatly solved this problem at a total cost of about $80. Now the service man writes out his requisition, puts it in the basket and shoots it across to the stockroom. The stockroom puts the required part in the basket and shoots it back. Instead of having to wait at the window, the service man keeps on working. And there is no temptation to talk about the World Series meanwhile, either.

•

Jib Cranes Improve the Handling Picture

DANIEL BERG, *Bridgeport, Conn.*

A large factory that has for years been using roller conveyors and overhead traveling cranes, has just recently added jib cranes to its materials handling equipment.

By so doing the speed of moving parts from one place to another has been increased, an important asset in some locations where storage space is scarce or unavailable. These jib cranes have speeded up transfer of material to and from machines. This means improved operation, which saves money every day.

The type of crane chosen was one with an upright that extends about 12 feet above the floor, with a jib about 12 feet long extending out at right angles. On top of this jib is an air lifting device which is mounted on a wheeled truck. Tracks have been placed along the top of the jib to accommodate this wheeled truck. Therefore the lifting device can be moved manually to any position on the jib, and the jib itself can be swung to any position in the arc. The manual operation is not strenuous, and the power lifting device is fast and positive.

With the use of these jib cranes, it is possible to move material over a distance of 24 feet, and they have extreme flexibility anywhere in this area. It leaves the traveling overhead cranes free for other work, and gives assurance of dependable service in the areas where they are used. The application of power is simple, and only affects the lifting mechanism. Due to this simplicity there has been occasion for practically no repairs. Therefore, delays have also been negligible.

Another fine thing is that these jib cranes are only 12 feet above the floor, and therefore do not in any way interfere with the operation of the overhead traveling cranes in the same area.

The jib cranes are being used in local areas for feeding certain machines; at pickling and cleaning operations; for transferring stock; for lifting filled cases at the scales; for movement of materials at annealing operations; and for positioning cases to be loaded into railroad cars. They are dependable, fast, and economical.

Management, How Good Is Your Control?

Ask yourself these questions to check up

3. PRODUCTION STANDARDS

1. What production standards have been set for your unit? Do you understand, in a general way, how they are arrived at?
2. Do production standards include any kind of quality control? What provisions have you personally made for controlling quality?
3. Have you done everything within your power to improve the production standard of your unit? Are standard motions and procedures being followed? Are layout and equipment satisfactory? Are working conditions satisfactory? What can you do to improve them?
4. What is the production standard set for each machine? Why does standard for each machine differ from all the others?
5. Have any radical changes been made in motions, procedures, layout, equipment, or working conditions, since production standards were set, which would warrant their being restudied and reset? To whom do you make request for any such restudies?
6. How is the performance of your personnel under production standards? Is it satisfactory to you? Are the standards possible of achievement? Are they too easy to reach? Too difficult?
7. Are you helping each man in your unit reach and exceed production standards by retraining him in standard work habits, and by helping him with tactful, constructive correction and demonstration?
8. Do you know whether your unit's production performance is improving or not? And how much? Are you satisfied with the progress made?
9. Are you familiar with the elements that go to make up your production standards? Sufficiently well enough to explain them to your men? Do you understand the reason for rest and fatigue allowances? The rating of operators used to set the production standard?
10. Do you understand the relationship between your production standard and the amount of parts or orders turned out by your unit?

Next Month: Training

Prepared by HARDING PALMER, *Industrial Engineer*
Lockheed Aircraft Corporation, Burbank, Calif.

MAINTENANCE SERVICES

SELECTION

INSTALLATION

INSPECTION

UPKEEP

ORGANIZATION

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FACTORY MANAGEMENT and MAINTENANCE

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

EDITORIALS

L. C. MORROW . . . *Editor*

This Is No Time to Lower Maintenance Standards

THE TEMPO OF OPERATION has been greatly stepped up in many plants. Production departments are being hard pushed. Equipment is being worked to the limit. Stern demands for more speed are being flung at operating executives from every direction.

Maintenance, as usual, is right on the firing line. Its problems and duties have been increased and the time allowed for doing them has been shortened.

Under strong pressure to get things done with the maximum possible speed the urge to cut corners and skimp details is something that must be reckoned with. Production does not always understand why it takes so long to run new power lines, build foundations, or inspect and adjust equipment. And many times, of course, the question of making only a temporary installation comes up. Any maintenance chief who lets himself be forced or persuaded into taking chances or doing things which his knowledge and experience tell him should not be done is piling up trouble for the future.

This does not mean that no effort should be made to find quicker and better ways of doing all the work for which maintenance is responsible. That ought to be the object of a never-ending search. It is quite a different matter to sanction slipshod workmanship and the neglect of precautions and principles which experience has shown are essential to satisfactory results.

Nothing is gained by saving a few hours, through the use of doubtful expedients, at the risk of delays and trouble ever after.

Don't Allow Operators to Overload Factory Elevators

OVERLOADING OF EQUIPMENT is never good practice because it leads to breakdowns and short life. Failure of some kinds of equipment may entail no more serious consequences than a production delay. Breakdown of others is almost certain to cause injury or death, along with heavy damage and disruption of vital facilities. Elevators are a good example.

Proper inspection and maintenance are not difficult to secure. They are largely a matter of good supervision and therefore are subject to executive control. Supervision over operators is likely to be considered of less moment, and receive only perfunctory attention. In reality the elevator operator is a highly important link in the chain of safeguards. Unless he is properly instructed in, and rigidly observes, all safety regulations, the likelihood of accidents is greatly increased.

In particular the temptation to overload elevators is something which must constantly be fought. When loads keep piling up, as they frequently do, the urge to put on a few more boxes may be hard to resist, unless close supervision makes detection certain.

A temporary advantage may be gained by overworking an elevator, but the risk is serious and much, including life itself, may be lost if some vital part fails.

New Insulating Materials Solve Old Problems

IT HAS LONG been recognized that the insulation used on wires falls considerably short of perfection. The only thing that could be done, however, was to put on the best insulation that existing knowledge and materials made available, and search unceasingly for something better. During the past few years much progress has been made in the development of insulations possessing qualities which were dreams rather than realities a comparatively short time ago. In these advances there will frequently be found the solution of troublesome problems for the maintenance department.

There is now available, for example, one grade of rubber insulation which can safely be operated at 75 degrees Centigrade, while another new grade can be used at 60 degrees without serious loss of insulating value or physical qualities. This means, of course, that the safe carrying capacities have been increased.

From time to time so-called synthetic insulations have made their appearance. Besides possessing qualities which make them particularly suited to conditions present in some installations, their use brings economies deriving from their high current-carrying capacities and smaller conductor diameter.

Official recognition has been given to some of these new insulating materials in the 1940 edition of the Code. They offer a satisfactory and economical solution of several problems which have to be faced in practically every plant.

Everyone who is concerned with wiring problems will do well to become thoroughly familiar with the possibilities and advantages of these new materials.

When Motors Make Too Much Noise

It may be due to any one of several causes, frequently windage or magnetic action. Whatever its origin, much can be done to reduce noise if one tries hard enough

A. A. CURRIE

Generator Engineering Department
Westinghouse Electric & Manufacturing Company
East Pittsburgh

NOISE CAN BE GENERATED in electrical machinery in several ways. For example, as the speed of the rotating member increases, the air surrounding it begins to move in an irregular manner. Most of it is impelled radially where, if it meets obstructions, it may produce a siren effect. Some of the air rotates with the motor but at reduced velocity, so that it forms eddies around projections on the rotor. Additional eddies are formed as the air moves through the ventilating passages in the frame. The irregular movement of the air in forming and dissipating these eddies results in noise.

Everyone knows that noise of any kind is bothersome. It is not so widely appreciated that noise may have an adverse physiological effect. Where the sound level is high, the primary effect is to make the listener physically tired. If the sound level is not only high, but also has a high-pitched component, such effects as headaches or ringing head noises may be produced.

Before going into the causes and cures of noise in rotating machinery, it may be of interest to ask, "How loud is loud?" The most commonly accepted unit of sound intensity is the decibel (db.), although it is not a direct measurement of loudness as heard by the ear. That is, a sound of, say, 100-db. intensity is not twice as loud as a sound of 50-db. intensity. The problem of mentally associating loudness levels and sound levels in decibels is similar to associating a given heat sensation with a corresponding temperature level. As an aid, the sound levels in decibels characteristic of some well-known locations are:

Soundproof room	10–20
Average dwelling	30–40
Average office	55–65
Average large motor	75–85
Railroad car	80
Heavy street traffic	90
Punchpress	110

Above levels of 120 decibels we enter what is known as the "threshold of feeling," where vibration of the air is felt rather than heard.

Basically, windage noise can be reduced in three ways: By decreasing the air flow through the machine; by controlling the manner of the air flow; by muffling the windage noise.

Reduction of air flow through the machine is not desirable in most cases since any decrease is immediately reflected in an increase in temperature. It is sometimes possible, however, to reduce the sound level by this means and still keep the temperature rise at a low value.

Limit Air Flow

On motors whose rotors have long coil extensions, additional banding will limit the air flow radially through the coil extensions and reduce the siren effect prominent in some machines. Where this procedure is not practicable it may be possible to cover the stator coil extensions partially by means of a cylindrically shaped piece of micarta or fullerboard. Or the baffling material may be placed under the rotor coil extensions. Figure 1 illustrates these methods of reducing air flow at this

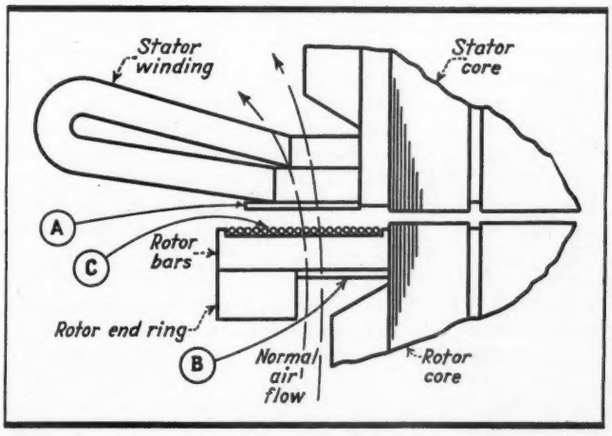


Figure 1. Windage noise is reduced by, A, micarta or other shields on stator coils, B, below rotor bars; C, banding rotor bars

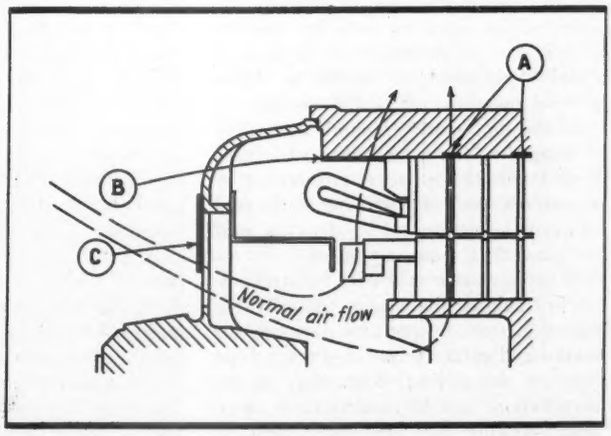


Figure 2. Air flow can be cut by, A, strips between ribs to block ducts, B, along inner edge of ribs; C, end-opening shields

point. Another method involves decreasing the number or size of the blowers or placing them closer to the shaft, so that they will develop less pressure.

A more drastic measure is to baffle the path of the air through the machine by reducing the size of the air passage, either ahead of or in back of the blowers, or by blocking off some air ducts in the stator. These expedients are illustrated by Figure 2. Obviously they are better adapted to use by the manufacturer, but when necessary the user can employ any of them if the motor construction facilitates disassembly.

Control of air flow through the machine offers good possibilities in noise reduction. The problem is, however, one for the manufacturer since there is little the user can do about it. By controlling the air flow I mean the provision of special paths through the machine by which the ventilating air can cool it adequately, without coming into contact with rotating parts in such a manner that eddies or jets are formed.

Mufflers Are Easy to Apply

Although prevention is usually better than cure, the third method of reducing windage noise, by muffling, is valuable in that a user can adapt it to suit his motors. Windage noise can be muffled by the provision of internal ducts that force the air to move around several turns before it reaches the exhaust opening. In some cases the ducts can be lined with a sound-absorbing material which will markedly attenuate any high-pitched noise present.

Where the air velocity in a duct is low—400 or 500 feet per minute—an unsupported lining of soft hair felt or a suitable commercial sound-absorbing material can be used to advantage. Either material may be cemented to the sides of the duct, or held by washers and bolts. A thickness of ½ inch is usually sufficient to muffle a high-pitched noise of, say, 2,000 cycles.

If the air velocity is high and there is danger of the material shredding, it is advisable to support it throughout by a coarse screen, such as expanded metal of about ½-in. mesh, bolted to the wall on about 1-in. square centers.

Windage noise may also be attenuated by making the motor partially enclosed instead of open; by directing air intake and exhaust openings toward the floor or the ceiling, depending on the installation; and by making these openings suitable for the attachment of mufflers, if needed. Figure 3 illustrates the use of a muffler on a large high-speed induction motor. The motor was originally built without mufflers. That is, it did not have the wood structure shown, or the horn-shaped intake mufflers on the brackets. To reduce the sound level, ducts and mufflers were designed to be attached to the exhaust ducts on each side of the machine.

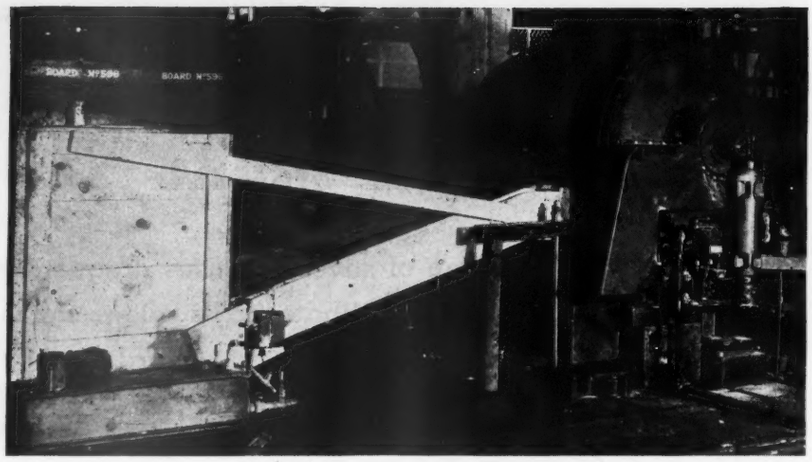


Figure 3. Sound-absorbing intake ducts and muffler for a high-speed induction motor

The muffler consisted of a box with shelves or baffles on the inside to force the air to follow a long path before being released. Interior surfaces of the muffler and the duct were lined with 1-in. sheets of a sound-absorbent material. The horn-shaped metal ducts on the intake openings were also lined with the same material. With this muffler system the sound level of the machine was cut from 115 to 85 decibels, a reduction in loudness of about 90 percent. This arrangement was so effective that the same type of exhaust muffler was built by the user with the muffler below the motor floor (Figure 4).

Even with an open motor the use of a hood over it, lined with a sound-absorbing material, will result in considerable reduction in sound level. Most machines built several years ago were entirely open, but it is often feasible and not costly to build an enclosure around the motor, leaving the top open. If a shield is put over each bracket and all members are lined with some sound-absorbing material, the reduction in sound level will be very marked.

Where it is impracticable to provide such a muffler, considerable reduction of noise in a given direction is often obtained by using a simple shield covered on one side with sound-absorbing material and set up near the motor. If, however, the motor is mounted near hard-surfaced walls or some other reflecting medium, this method may fail due to the presence of reflected waves. It is even possible for the sound level at the working area to increase somewhat where the direct and reflected components had previously canceled one another to some extent.

In the magnetic system of the machine the periodic variations in the magnetic forces can cause slight movements of teeth, endbells, covers, and even frames, and if any of these structures happens to be nearly resonant to the exciting magnetic force, the amplitude of vibration may rise to a point where resulting noise is objectionable.

Magnetic Noise Elusive

Magnetic noise is commonly much harder to combat than windage noise, but when the cause of noise and vibration of a magnetic nature is recognized, much can often be done to reduce them. It is difficult to predict the action of a given machine under the influence of stray magnetic fields. The shapes involved are so complex and stray magnetic action is so unpredictable that neither the frequency of the exciting force nor the natural frequency of the motor structure can be calculated satisfactorily. Therefore it often happens that one machine will be quiet magnetically, while another machine of similar rating will be noisy.

Where the motor frame is rather small and rigid, not much can be done to reduce magnetic noise. With machines of larger size or fabricated construction, the frame cover, endbells, or the frame itself may be more or less resonant to a particular exciting frequency, with resultant noise of magnetic origin. Segments pressed from sheet steel and assembled to form open endbells may vibrate either axially or radially due to exciting forces generated

on the frame or to the magnetic field around the end turns of the armature winding.

This vibration can be reduced or stopped by changing the natural frequency of the endbells or by damping the vibration directly.

The most convenient manner of changing natural frequency is to bolt a ring around the outer edge of the endbell. Short sections of steel bar bolted to each segment will often accomplish the desired result. As long as the endbell is not stiffened in proportion to the extra weight added, the natural frequency of the system usually will be changed enough so that it will not respond to the exciting force.

Vibration of endbells can be damped most easily by using rubber as a damping medium. Rubber washers are placed on both sides of the endbell segment on the supporting bolt, maintaining sufficient clearance between the bolt and the segment so that there is no solid contact between the frame and the segment. By varying the compression of the washers while the machine is running a point will be found where the energy in the vibrating endbells is almost totally absorbed by the washers.

Any vibrating member may be dealt with in the same manner, with the exception of those within the motor which usually cannot be reached after assembly. In dealing with a larger member than an endbell, it is usually easier to add a stiffening member to change the natural frequency, rather than to attempt to add weight. It would obviously be impracticable to add sufficient weight to change the natural frequency of vibration of a cover which in itself might weigh several hundred pounds.

The sound level of a completed installation may be considerably different than the sound level as measured by the manufacturer, due to the nature of the installation. Many machines are installed in small rooms with hard-surfaced walls; such conditions are favorable to the formation of standing waves, or resonant amplification of some particular note emitted by the motor.

Influence of environment on machine-produced noise is so broad in scope that only a few general principles can be given. With these in mind, however, the great majority of noise problems can be solved. A surprisingly large amount of vibration can be transmitted through the motor mounting to the foundation and thence to structures near the motor. In one instance the isolating medium between a large motor and the foundation was incorrectly constructed, and the small amount of vibration thus transmitted to the building was apparent in walls around a column several floors above the motor room.

A small motor often is supported in a cradle with rubber inserts at the points of support. If the natural frequency of the motor and the supports is well below the lowest possible exciting frequency, the system will transmit practically no vibration to the foundation. With large motors such a supporting system is not feasible, but it is possible to mount the motor and the driven machine on a common foundation, and then isolate this foundation from the building by means of a resilient material. If the natural mechanical frequency of such a system is not more than one-third the motor speed in revolutions per minute or the exciting frequency, whichever is lower, the transmitted vibration will be very low. Natural frequency of such a system is:

$F = 3.13 \sqrt{1 \div d}$, where

F = Natural frequency in cycles per second

d = Deflection of support in inches

The effect of isolating the foundation is often partially or wholly nullified, however, by the use of a solid conduit connection to the motor, or solid piping to the driven machine. Solid members of this sort are effective in transmitting vibration to the building, and should always be avoided if possible. If they cannot be eliminated entirely, they should be flexibly supported from the structure for as great a distance as possible. With a low-voltage, high-current motor whose leads must be large, flexible connections should be made to the supply system through the use of copper braid or extra-flexible cable.

Treating the Walls May Help

Avoid hard-surfaced walls in motor rooms. because the efficient reflection of sound from such surfaces will often cause the production of standing waves. That is, a reflected wave will be directly in phase with a transmitted wave between the motor and a wall, and the sound level will build up until dissipation of the sound energy in other directions equals the wave energy from the motor.

A small room is also conducive to the formation of standing waves; if it is necessary to install a motor in a small room with hard-surfaced walls, it may be desirable to cover them with a sound-absorbent material. Where this cannot be done, but the room is provided with windows, leaving the latter open will help to dissipate a part of the energy.

If nothing can be done to cover the motor or change the walls of the room, a change in the location of working spaces will sometimes help considerably. For example, in an office adjacent to a power station the sound level just above a desk was 87 decibels. It was apparent that the noise from the station was producing standing waves in the office; therefore, an attempt was made to find a point of minimum wave amplitude. By moving the desk and chair about 2 feet from their original position the sound level was reduced to 76 decibels, a reduction of about 57 percent in loudness. This is possibly an extreme case, but it is illustrative of what may be done.

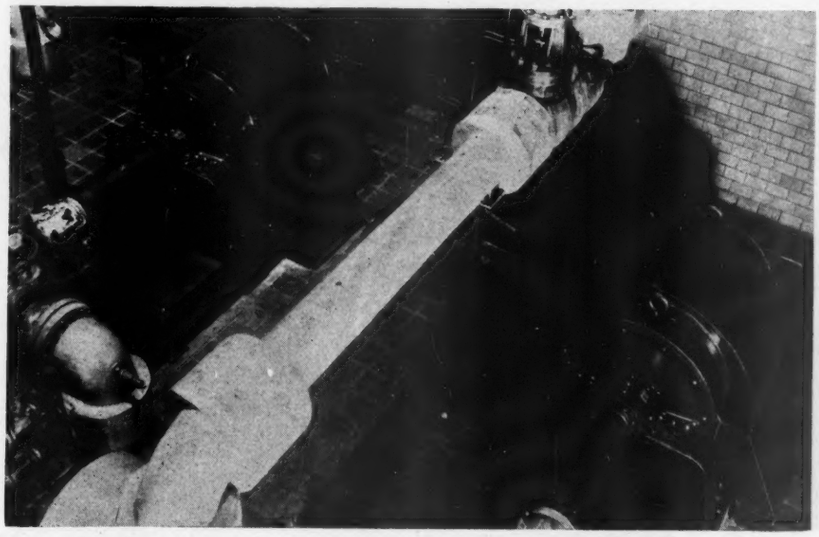


Figure 4. These motors were provided with ducts and mufflers like those in Figure 3

Bright Lights Show Up Intruders

Eight Westinghouse floodlights subject the yard of a Mid-western plant to a barrage of light through which no one can pass unseen

Here an average of 2 foot-candles, enough for protection and many activities, is provided by Holophane refractors with 300-watt lamps

Night brings no darkness or dangerous shadows to this plant, with its skillfully placed Benjamin floodlights

When the sun goes down General Electric floodlights take over the task of protecting these plant buildings

Guarding Against the Saboteur

Had a good fence. Got some good lights. Doubled their plant protection force. Would-be saboteurs who think this plant easy pickings will have another think coming

W. J. BARCLAY
Director of Personal Relations
Campbell, Wyant, & Cannon Foundry Company
Muskegon, Mich.

A TELEPHONE CALL in the night. A bomb "found" just outside the fence. The phone call a phony. The bomb real enough, but its mystery quickly solved by local law enforcement officers. No harm done. But enough to remind a company doing work for the government that there *will* be saboteurs. Those of us who recall 1917 will lay to that.

First line of defense against the activities of these bomb-planting gentry is out where the plant begins. The problem is to keep out the saboteur and his bombs. Three things are needed—a first-class fence, plenty of light in every corner of the plant property, and a well-trained, well-paid, well-uniformed, well-armed plant protection force.

We had the fence—nearly a mile and a half of it, completely surrounding the plant's 46 acres.

We got the light—by installing a battery of floodlights on the water tank.

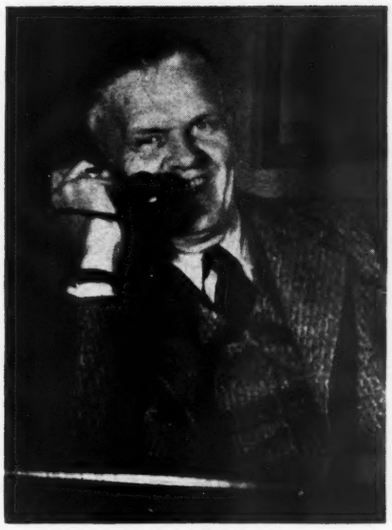
We almost doubled our plant protection force.

Now don't jump to the conclusion that we are jittery. We are not. We are just careful. Just seeing to it that nothing within our control stops us from carrying out our small part of the national defense program.

First thing was to take the employees into the company's confidence. We explained that it had become necessary to take more precautions for employee and plant protection than ever before. Said we were going to inspect lunch boxes and any other packages that employees might want to take into the plant. Explained further that condi-

BE CAREFUL TODAY
SAFETY STARTS WITH YOU
HEADQUARTERS
C.W.C. FOUNDRY POLICE
SPECIAL DEPUTY SHERIFFS FOR MUSKEGON COUNTY
STOP
EMPLOYEES MUST SHOW THEIR BADGE to enter Plant and wear same in plain sight while working.
EMPLOYEES NOT WORKING SHIFT ARE NOT ALLOWED TO ENTER PLANT EXCEPT ON SPECIAL PASS ISSUED BY EMPLOYMENT OFFICE

Chief Rodin and a helper "frisk" lunch boxes and thermos bottles. No one enters the Campbell foundry without this examination



William John Smalwell Barclay's folks died when he was small. So Bill went to work, aged 12, at whatever he could get when he could get it. At that he finished high school at Menominee, Mich. Has since taken extension courses at Northwestern, LaSalle, Hamilton Institute, NMTA and Seegur Trade Schools. Served 13 months with Canadian Expeditionary Force. Previous posts: Employment Manager, Reynolds Spring Company, Jackson, Mich., 1922 to 1926; Continental Can Company, Chicago, 1926 to 1933. At Campbell for the past 6½ years

tions might arise that would compel the closest inspection of employees' personal property at any time.

In short, we asked for cooperation—and got it. Every man who enters the plant today opens up his lunch box, unscrews the cover of his thermos bottle. There is never a kick. The company made it very plain why it had to insist on such an "invasion" of private rights, and the men comply with much more grace than one would expect.

Lighting the plant property was a relatively simple procedure. There were already floodlights at strategic locations, designed to supply plenty of illumination just outside plant buildings, on plant streets, etc. But out around scrap piles and fences there were deep shadows galore. Despite careful patrolling, an ambitious saboteur could have slipped in unseen.

Light Chased Shadows

Tonight it would hardly be possible to draw up a chair by the fence and enjoy the sporting page of the newspaper, but you *could* stand at the fence, pretend you were a watchman, and be sure that nobody was going to get over or through the fence without your seeing him. Credit the battery of eight 1,500-watt lamps placed high up on the plant water tank.

I said "almost doubled the plant protection force." Number is important, but not half as important as the kind of men chosen to do this job. Forgive my editorializing a bit, but if I had my way there would be a sign in every gatehouse in every industrial plant in the country. It would read something like this: "Doddering oldsters, keep out!" There will never be a better time than the present emergency for American industry to stop making watchmen out of long-time employees who can no longer do a day's work in the plant but have to be taken care of somewhere, somehow. I say that operating executives who continue this well-intentioned practice are endangering not only plant property and plant processes, but also the lives of company employees! For having a plant protection force made up of amiable old-timers is like sending the saboteurs an engraved invitation to drop in some night and leave a couple of mementoes behind them.

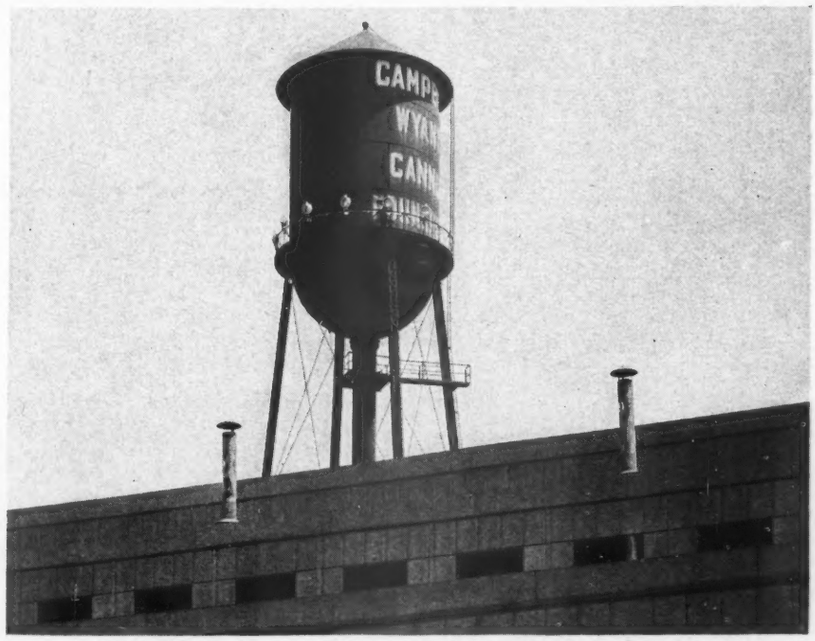
This company, to get back to our own experience, is seeing to it that the men at its gates are physically fit and properly equipped to handle any situation that may come up. The company makes it clear to them from the start that theirs is an important job, that the safety of employees, buildings, and equipment—indeed, the livelihood of several thousand local residents—is largely in their hands.

All members of the force are special deputy sheriffs for Muskegon County and must therefore maintain their dignity as law enforcement officers. They are instructed not to become overly friendly or familiar, never to indulge in horseplay. Good personal appearance is required. Men are expected to shave daily, keep their shoes shined, their uniforms in good condition, and look generally neat at all times.

New plant protection men are taken on as probationers for the first 30 days of service. This permits the supervising officers to determine whether or not they have the ability, tact, and alertness needed for this kind of work.

To attract the right kind of men, rates paid are comparable to those earned by regular law enforcement officers in the community. The work week is 55 hours, with time and a half for overtime. Rates are high enough so that men, without financial burden, can equip themselves with uniforms. An arrangement with a local merchant enables them to secure the necessary clothing with a small down payment and small semi-monthly installments. Guns, holsters, belts, ammunition, badges, caps, flashlights, and raincoats are furnished by the company.

General and specific instructions are



On the water tank, a battery of eight 1,500-watt floodlights. A saboteur would have to go some to climb the fence and not be seen by one of the plant protection men

NOTICE!

Due to existing conditions and the fact that this Company is engaged in work for the U. S. GOVERNMENT it becomes necessary for us to take more precautions for employee and plant protection than ever before. We appreciate the co-operation our employees have always given us in the past and we know they will continue to co-operate in this respect. Already inspections of packages and lunch boxes have been made. Conditions may arise that compel the closest inspection of employees' personal property at any time.

In order to do our part in this protection, we hereby offer the following:

REWARD

We will until further notice pay the sum of two hundred fifty dollars ($250.00) to any person furnishing information which leads to arrest and conviction of any person performing any act of sabotage or malicious destruction of company property which interferes with normal production.

CAMPBELL, WYANT & CANNON FOUNDRY COMPANY
D. J. CAMPBELL, President

July 15, 1940

contained in a 24-page booklet issued to members of the plant protection force. Each man is required to familiarize himself with the general rules and to learn and obey the specific instructions pertaining to his post. To illustrate how specific the instructions are, take those for Post No. 3, which includes "service buildings and entire rear yard from yard castings conveyor to sand sheds." Here are the duties of the men on this post:

1. Make A. D. T. rounds as directed.

2. Permit no loafing or smoking in toilets.

3. Permit no employee to wander around buildings, yard, or equipment.

4. Check line fences, material piles, gates, at least once every two hours.

5. Visit kennels. Feed and water plant protection dogs.

6. Keep all gates locked during night-shift hours except when otherwise instructed.

7. Prevent theft of employee or company property.

8. Prevent acts of sabotage.

9. Permit no one to enter or leave premises over gates or fences.

10. A plant protection dog must accompany and assist you in your duties; his hearing and sense of smell are far superior to yours in detecting unsuspected persons in your vicinity.

11. Tower man will keep constant vigil and report to the ground patrolman any suspicious condition he may sight from his observation post.

12. Carry out to the best of your ability any special orders given to you by your superior.

Orders by Loudspeaker

Equally explicit are the instructions for each of the other posts. Communication is by a 20-station loudspeaker system. In an emergency we can thus get a message instantly to every man on duty.

As I said at the outset, we are just being careful. Some of our work is directly related to the national defense program. We conceive it our duty to employees, company, community, and nation to see that our part of the program is not interrupted for a single moment or in a single particular. We aim to make it tough for the saboteur who is chosen to "get" our plant.

At the north gate. Trucks are checked in and checked out. Above, a reward notice that was posted after the company had had a couple of minor scares. It explains why it has become necessary to search lunch boxes. Employees don't grumble

We Paint as Needed

Some surfaces require attention more often than others; which means inspect buildings and equipment frequently

The author casts a canny eye at some steel sash which needs a new overcoat. It's painted so frequently, one coat is usually enough

C. Y. CHAPMAN

Superintendent, Buildings and Grounds
Caterpillar Tractor Company, Peoria

IN MAINTENANCE PAINTING around our sizable plant we do not hold with the doctrine that the true religion is to have a regular schedule of how often each kind of painting shall be done, and then stick to it. We hold to the old-fashioned idea of painting each unit inside or outside when it needs it —not before, and certainly not long after.

It is not possible to forecast precisely how long a given paint job should last before it needs renewal. Conditions around an industrial plant change too rapidly and too unexpectedly to permit such predictions, even if everything else were exactly alike from year to year. Corrosion from various causes is not constant and makes the necessity of repainting a matter of judgment rather than a set schedule.

Our painting policy might be termed preventive. We try to keep all our painted surfaces, whether exterior or interior, in such good shape that they never need more than one coat. As soon as we see a building or any other painted unit starting to go, we mark it down for early attention. And we try to do the listed jobs in the order of their need, giving attention first to those that are in the worst condition.

Outdoor jobs are saved for the spring unless some emergency patching is required. The actual volume of interior painting is considerably greater than the volume of exterior painting,

since almost all our major buildings are brick and only the older ones have wood trim. Of our total paint gang of approximately 30 men, from half to two-thirds are kept busy outdoors in dry weather from April to November, while the others work inside on the painting jobs which cannot be postponed. In the fall we move the entire gang indoors, and keep them working inside until the weather warms up next spring and permits us to resume our campaign against the inroads of climate.

Our biggest segment of outdoor painting is sash, whether wood as in our older buildings, or steel as in those built later. We use lead and oil on wood sash, and black silica graphite on steel sash. We keep ten to fifteen men working all summer on sash, and find that we can count on approximately the same square footage of window space to be handled in an hour as we expect with plain surfaces, such as the side of a building. Our average expectation is 100 square feet per hour, although this amount varies with the type of work and especially with the height; no man can turn out the same volume of work when he is supported from the ground or suspended from the roof that he can when he is at ground level and does not have to spend time moving his scaffold around.

Many Paints Tried on Wood

Probably our second largest unit of exterior work, barring an unusual season, is wood trim on the older buildings. On such surfaces we use either lead and oil, or a ready-mixed paint from some good source. We keep experimenting with various paints for exterior wood surfaces, especially because formulas are nowadays changing so frequently that it is necessary to keep checking up.

We have a good deal of outside sheet metal, which we coat either with aluminum paint or graphite.

Our three water towers and tanks, each about 125 feet high, get black graphite outside; inside, after the tank has been drained and allowed to dry, we use a primer and then finish up with black asphaltum. These tanks are used principally for sprinkler system supply and process water, which does not need to be kept taste-free.

Flagpoles get black enamel, chiefly because it looks dressy.

Fences are sprayed with aluminum, except for one green fence in front of the bleachers on the employees' ball field.

Stacks and breechings are coated with paints suitable for the temperature. High-temperature stacks get high-heat aluminum. Low-temperature stacks get flake silica graphite in linseed oil, which we buy ready-mixed.

Garages for employees' cars get black graphite on the sides and roof, which are all of corrugated sheet metal.

The baseball bleachers and athletic field equipment are sprayed with synthetic enamels. These surfaces, incidentally, are painted every year not so much for protection of the equipment as to give a fresh and festive appearance particularly at the opening of the spring season.

Our interior painting methods are probably much the same as those of most other plants. We use acid-and-alkali-resisting enamel on production equipment, to combat the inroads of cutting compounds.

Factory ceilings and sidewalls receive mill white, office ceilings and sidewalls flat wall paint.

Hardwood floors are oiled with linseed oil; concrete floors are protected by concrete paint.

Heating pipes receive aluminum paint, while heating and air-conditioning ducts receive mill white or flat wall paint, depending upon whether they are in the plant or in the office.

In laboratories and photographic rooms we use acid-resisting finishes, whether paint or varnish.

Satin-finish varnish is used on wooden partitions and dividers in the offices.

A considerable volume of work comes to the painters from the carpenter shop because we do a large proportion of our own woodworking and cabinet making. Oak work tables, for instance, come to the shop all sanded and ready for stain and varnish. Dividing partitions are made in the carpenter department's mill, come to the paint shop for fill, stain, and first coat; then they go to the point of use, where they are glazed and the finish coat is applied.

"WHAT INDUSTRY CAN DO FOR AMERICA" IN POSTERS, FILM, AND PAMPHLETS

To facilitate wide dissemination of the story of what industry can do for America, as published in its August issue, FACTORY has arranged for reproduction in poster, sound-slide film, and pamphlet form.

Posters, in color, are being produced and sold by Graphic Chart Service, 2-140 General Motors Bldg., Detroit.

The sound-slide film is being distributed by Eugene J. Benge, 20 North Wacker Drive, Chicago.

Pamphlets are being sold by the Sheldon-Claire Company, 520 North Michigan Ave., Chicago.

Sewers Needn't Become Clogged

Use of stilling basins and suitable manholes at the proper places will go a long way to prevent stoppages of sewers by bulky masses or accumulations of sediment

JOHN H. STOUTENBERG

Assistant Plant Engineer
Stanley Tools Division of The Stanley Works
New Britain, Conn.

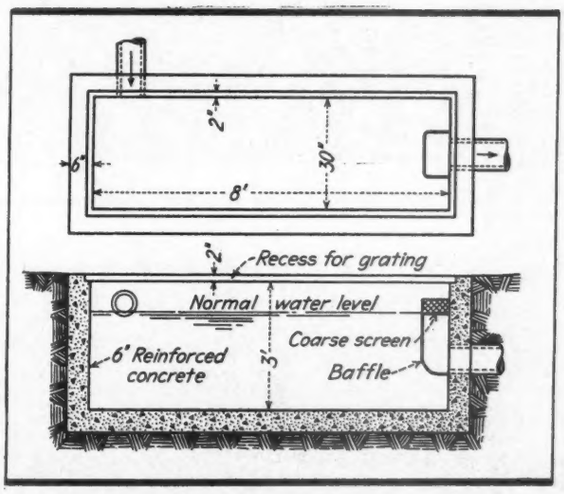
WHEN A SEWER carrying industrial waste becomes plugged, the usual procedure is to call out the yard crew and try to flush out the obstruction. Sometimes this effort is successful and the stoppage is removed, but the basic cause remains and the trouble recurs. At times flushing is entirely ineffective and the sewer must be dug up. Then the question is, where to dig. Usually the stoppage will be found either in an elbow or at an intersection with a branch line.

Stoppages are caused by bulky items and the accumulation of sediment. Those caused by bulky items may be avoided by screening the inlets to the sewer and by installing screens in the stilling basin or manhole through which the water flows, as shown in the accompanying illustration.

Sediment made up of a combination of grit and iron particles settles in sewer lines to form an exceedingly dense mass, which is almost impossible to remove, even when wet, except by digging up the sewer. An effective method of preventing this type of stoppage is to settle out the sludge before it goes into the sewer. It can be done in a stilling basin.

Basin Cuts Velocity

A stilling basin is one in which the velocity of the water flowing through it is much less than the velocity of the entering stream. It is analogous to a lake into which a swiftly flowing river runs. The theory behind these basins is that the carrying capacity of water varies directly as the sixth power of the velocity. Hence, if the velocity is halved, the carrying capacity is reduced to 1/64; if the velocity is cut to a third, the carrying capacity is reduced to 1/729. In order to settle out fine particles the rate of flow should be less than 0.5 feet per second.



Plan and elevation of stilling basin for sewers carrying industrial waste products. By settlement and the coarse screen, sediment and bulky items are trapped here

A good stilling basin can be made by the plant maintenance crew. The width should be such that a man can get into the basin and have room to shovel out the sludge: 30 to 36 inches will not be too much. Depth will usually be determined by the grade at which the sewer enters and leaves but should not be more than 6 feet for easy handling. Length depends on the storage capacity and hence on the amount of sludge it is desired to accumulate before removal.

A baffle is needed at the discharge end of the tank in order to prevent any of the settled sludge from being picked up by the increased velocity at this point and carried into the lines. A good spot to locate a stilling basin is just outside a building wall so that it is easily accessible. When the basin is full, the sludge is shoveled out and disposed of.

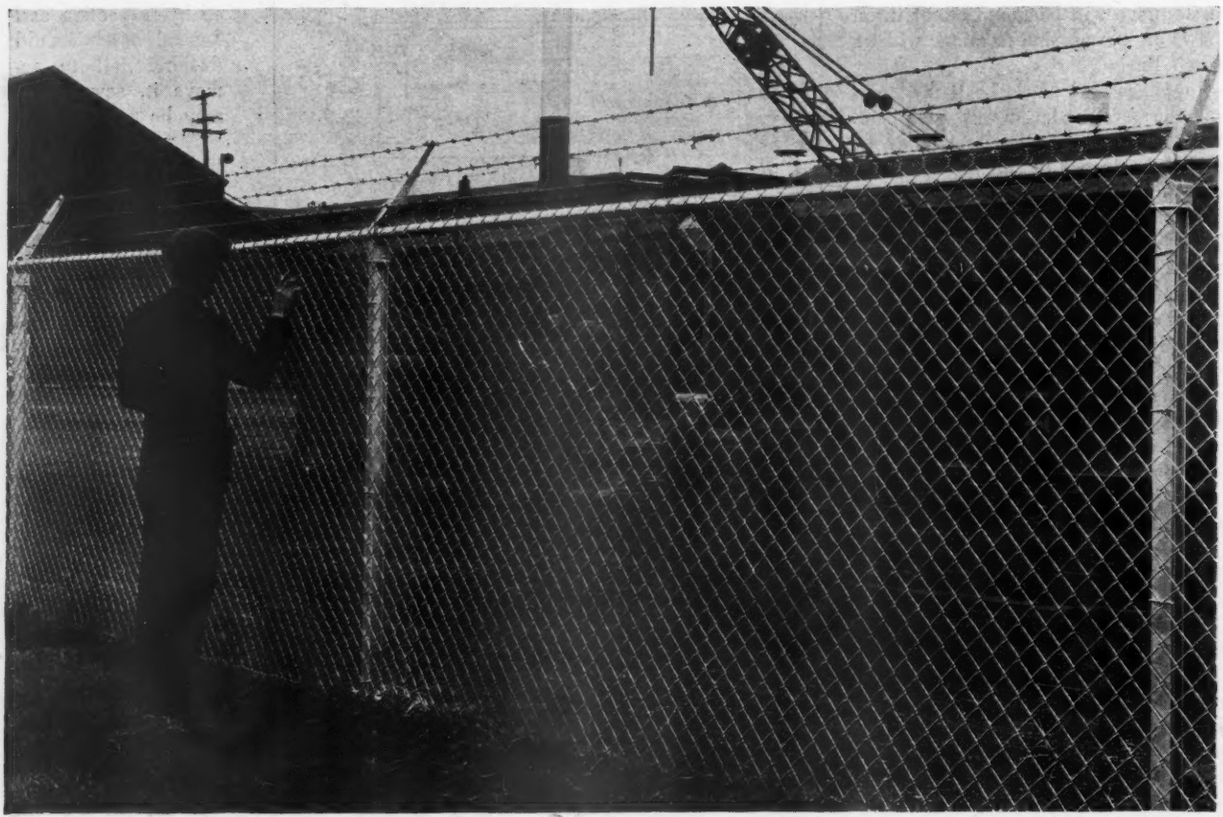
In addition to stilling basins it is highly desirable that manholes be installed at all changes of grade or direction, and at all intersections with branch lines. If this is done, all runs between adjacent manholes will be straight. Runs can be flushed at definite intervals without interfering with the normal use of the sewer. Any stoppage can readily be located by inspection and flushed out. Should flushing fail to remove it, sewer rods may be used.

A manhole should be installed so that its bottom is at the grade of the sewer. If it is made 4 feet by 4 feet square there will be ample room for a man to work without being cramped. Steps may be provided by embedding bent pieces of ¾-in. stock in the walls. Standard manhole covers should be used where trucking is done over the top of the basin; otherwise 3-in. plank will be satisfactory. Sidewall thickness depends on soil conditions, but it should be at least 6 inches of reinforced concrete, or the equivalent in brick.

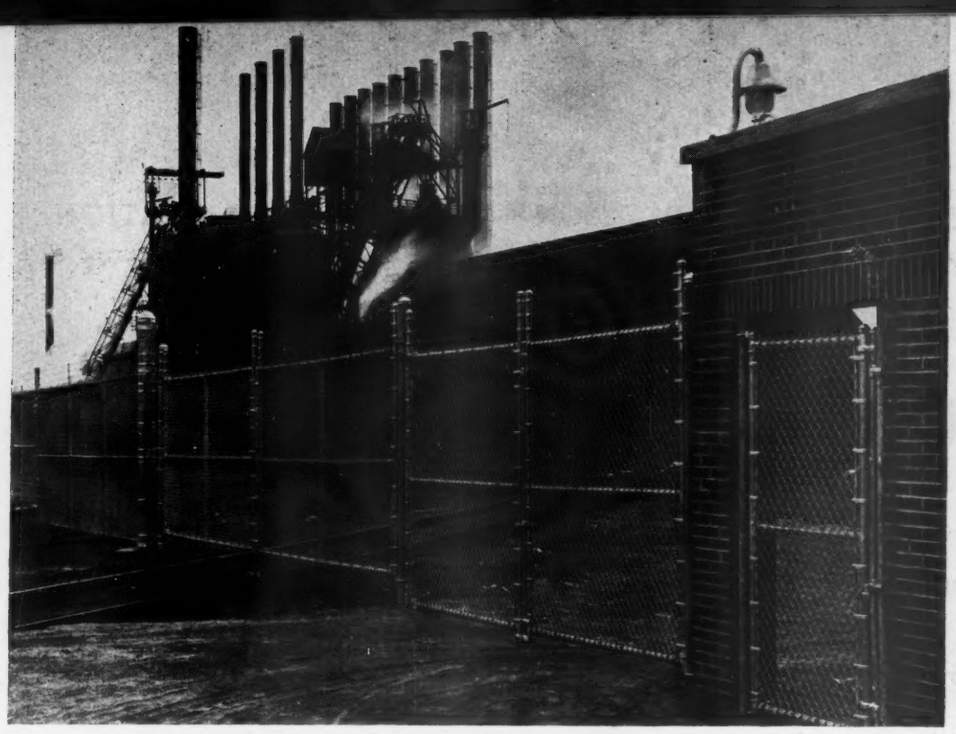
The installation cost of each manhole and stilling basin will be between $50 and $100, depending on the size of the structure and the local wage rates. A single stoppage can cost several times this figure when the cost of direct labor to correct the condition and the indirect cost due to loss of production are considered. It costs less to prevent interruption than to restore it.

Strong Fences Keep Outsiders Out

A Cyclone chain link fence 7 feet high, topped by six strands of barbed wire, presents a formidable barrier to all unwanted visitors



There's no harm in taking a look, but that is as far as anyone can go with the Page fence that protects this industrial property



Anyone who doesn't belong would have a hard time getting into or out of the grounds of one of the large steel mills. The plant is guarded by a Pittsburgh chain link fence 8 feet in height and more than 17,000 feet long

It's no trouble at all for the right people to get into and out of this plant at proper times and places, but a sturdy Continental Steel fence makes trespassing impossible for those who have no excuse for being found on the plant property

On this 7-foot Anchor Post chain link fence, which protects a large food products plant, the barbed wire arms are mounted vertically to avoid possibility of injury to or interference with the movement of personnel or vehicles within the grounds.

Maintenance Forms

2. Requisitioning the Material

After maintenance work has been requested and authorized, by means of the forms illustrated last month, next step is to secure material needed on the job. The forms shown here are used by maintenance men to order material from stores or purchasing

PURCHASING COPY **BUYER'S REQUISITION** — 1A

THE PURCHASING DEPT. WILL PLEASE ORDER THE FOLLOWING:

PURCHASE ORDER NO. M. O. 59219

PRICE					
TO BE USED FOR				DATE NEEDED	
G. O.	A. O.	C. O.	E. O. OR D.W.O.	JOB NO.	DEPT. NO.
SUPPLIER				F. O. B.	
				TERMS:	
DEPT. ORDERING	ORDERED BY		DATE	APPROVED BY	

DESCRIPTION OF MATERIAL — 1B

NAME OF SUPPLIER	PRICE	F.O.B.	DATE	O. K. INITIALS	P. O. NO.	E. O. NO.	JOB NO.	QUAN.	NEEDED

JOB NO.	FOR
L. SPEC.	
DEPT	

1. Wagner Electric Corporation. Forms for requisitioning materials for maintenance jobs. Material regularly stocked is requisitioned from purchasing department on *1B*, the purchasing department supplying information called for in first six columns, the maintenance department the rest. Special or costly material ordered on contract is requested on *1A*

SERVICE DEPARTMENT — **IS IT NECESSARY?** — 2

DATE 194

NO. OF ARTICLES	DESCRIPTION	QUAN.	CLASS	ITEM

PLEASE MAKE SEPARATE REQUISITIONS FOR EACH ITEM NUMBER

JOB NO.	DEPT. NO.

PRICE	AMOUNT	
		OVERSEER

2. Bigelow-Sanford Carpet Company, Inc. This form is used by a maintenance department to requisition repair materials from stores

CORNING GLASS WORKS

DEPARTMENT REQUISITION

Nº 56901

ORIGINAL—Send to Purchasing Department

PURCHASING AGENT: **Date** _____ 194__

Please furnish the following for use of _____ **Department:**

Quantity to be Ordered	ITEM

DATE:

MATERIAL

CREDIT ACCOUNT	CREDIT DEPT.	WORK BY DEPT.	CHARGE ACCOUNT	CHARGE DEPT.	PRODUCT CLASS	POT OR TANK NO.	SERIAL—BULLETIN OR EQUIPMENT NO.

3B

QUANTITY	DESCRIPTION	PRICE	AMOUNT
TOTAL			

DO NOT FOLD OR BEND THIS CARD

DATE PER	DATE WEEK	CREDIT ACCT.	CREDIT DEPT.	WORK DEPT.	CHARGE ACCT.	CHARGE DEPT.	CLASS	POT OR TANK NO.	SERIAL BULLETIN OR EQUIP. NO.	AMOUNT
45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80										

CORNING GLASS WORKS - CORNING, N.Y. 1933 (JAN) 50M

SIGNED

Will Substitution be Allowed? ____

Date Needed _____ **Required by** _____

Chge _____
(State Shop Order Number, Account Number or Purpose)

Approved by _____

3A

3. Corning Glass Works. Purchasing requisition *3A*, for material not in stores, is issued by plant engineering department through material clerk who keeps a duplicate to check receiving slip and invoice when material is received. Material needed from storeroom is requisitioned by maintenance man on the tabulating machine card form *3B*, which must be approved by the foreman

4

GENERAL REQUISITION **DATE**

STOREKEEPER: DELIVER TO DEPT. NO.	ORDER NO.	CHARGE DEPT.	CHARGE ACCT.	CODE	TOTAL AMOUNT

QUANTITY	DESCRIPTION	PRICE	AMOUNT

RECEIVED..... .....FOREMAN

DELIVERED..... .....STOREKEEPER

JOB NO. _____

5

4. Chrysler Corporation, Plymouth Division. On authority of maintenance foremen, material for maintenance jobs is requisitioned from stores on this form

5. A. E. Staley Manufacturing Company. Simplest form of all, by means of which any maintenance mechanic can draw necessary material from stores, requires listing of only job number and item wanted

Maintenance Service Shorts

Readers are invited to contribute brief illustrated articles reporting out-of-the-ordinary maintenance accomplishments. Accepted articles will be paid for

POWER, LIGHT, AIR CONDITIONING

Warm Air Curtain at Doors Lightens Heating Load

H. M. Ratley

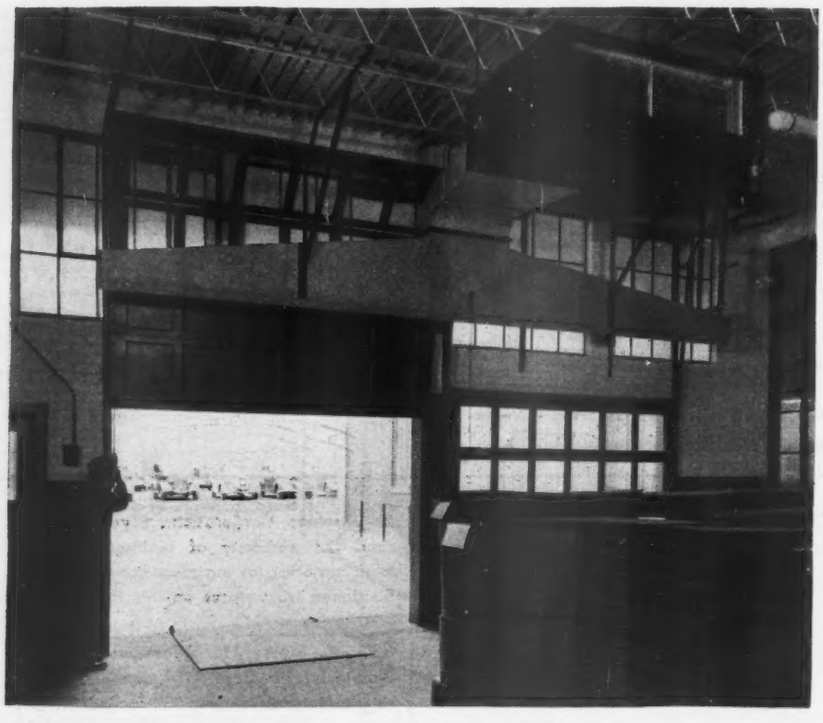
Superintendent of New Development
National Automotive Fibers, Inc.
Detroit

At five receiving and shipping doors in our plant, trucks load and unload. This means that, in winter, cold air from the outside enters and makes receiving and shipping people working in close proximity to these openings uncomfortable, unless some protective measures are taken. Production workers are not immune: The building is made up of bays separated by fire walls, but connected by a wide central aisle; if more than one of these large doors are open at the same time, as often happens, a cold draft is created which taxes on the factory heating system.

At each of these openings unit heaters have been placed which, with suitable sheet metal manifolds, provide a current of warm air to serve as a blanket and to mix with the incoming cold air and thus maintain an even temperature in the plant.

The installation shown in the illustration covers two receiving doors 18 feet wide. Experience dictated two new developments. In the first place, the downtake manifold, three inches in width, is inclined 20 degrees in the direction of the outside. This was done to prevent the current of warm air coming down from being deflected by the incoming current of cold air before it hit the floor. Secondly, a gate valve in the manifold, which is thrown by the hanging chain in the center, allows the current of warm air to be deflected to the door that happens to be in use at the moment. If both doors are open at the same time, the valve is in the neutral position, and both receive the down current of warm air. Pushbutton control at the man's left serves to start the 3-hp. motor when operation is necessary.

Not only is this arrangement a protection to the workers at the five receiving and shipping points, but the load on the general plant heating system is more evenly maintained.



Manifold extension of heater outlet forces warm air down to mix with incoming cold

•

Saved Power by Changing Date of Standby Contract

N. T. Pef, *Oak Park, Ill.*

Many industrial concerns, in place of spare generating equipment, have public utility power standby, and the usual contract specifies a minimum annual consideration, which ends and renews at the first of some month. It often makes a difference what month of the year is specified.

In the case of one concern the contract began and ended on the first of March; this date was probably selected because bought power was first used on that day. In this case the minimum annual payment was $4,400 which was equivalent to about 200,000 kw.-hr.

As very little use was made of the utility power each year there were about 200,000 kw.-hr. due, which had to be used during January and February. Since all of the exhaust steam from the generator engines was used for heating, use of purchased power during these two months was of no advantage as most of the gain was offset by the necessity of using live steam for heating purposes.

It was realized that if any benefit was to be derived from the utility power it had to be used during the non-heating season. With the contract ending in March, power due from the utility could not be used during the summer months, because then there would be no protection against breakdown during the last months of the contract.

The matter was taken up with the

Materials handling moves FULL SPEED AHEAD with Exide-Ironclads assembled in steel trays

FOR more speed in handling materials or freight—for more power in handling the big steel coils of the steel industry—equip your trucks with Exide-Ironclad Batteries assembled in steel trays.

They pack more battery power into the same space, enabling you to install a higher capacity, higher voltage battery in the battery compartment of a truck. The result is extra performance, extra pick-up, power and speed, combined with the long-lived dependability of the Exide-Ironclad Battery.

To simplify battery maintenance and minimize handling interruptions, investigate the Exide System. It includes the Exide Discharge Indicator which flashes a warning when a battery nears the discharge point, and the Exide Charge Control Unit which makes battery charging virtually an automatic operation. Write for free booklet, "The Exide System for Better Material Handling."

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

utility company which stated that it made no difference to them when the contract was dated; accordingly, the date was changed from March 1 to October 1. This has made it possible to use whatever utility power was due during the summer months, and has resulted in a saving of about 300 tons of coal per year. An additional advantage is that the main generating unit can be shut down during the summer months and any necessary work done during this time. This also applies for work to be done on other equipment as the load is very light during the time power is taken from the utility lines.

ELECTRICAL UTILIZATION

Radiant Heaters Replace Strip Type in Oven

EDWARD F. WELLS, *Assistant Manager*
The Special Leathers Company
Philadelphia

In one of our operations it is necessary to heat 200 pounds of leather bumpers in a wood-slat tumbler enclosed in an oven. The temperature has to be raised about 50 degrees in approximately two hours. Heat was formerly supplied by four 500-watt strip heaters, costing $3.85 each. For some reason, however, these heaters seemed to burn out in an unreasonably short time.

In an emergency, with all the strip heaters burned out, we installed two ordinary 550-watt radiant heaters of the type which can be purchased at the corner drugstore for about $1.50. We found that these two heaters, using half the current, do the job better than the heaters formerly used and last many times as long.

When the heating coils burn out replacement coils can be bought for 25 cents apiece, representing a saving of $14.90 over the replacement cost of the strip heaters.

•

They Overlooked the Limit Switch

DANA GIBSON, *Latonia, Ky.*

The mass and high inertia of the beds of 20-ft. planers make it necessary to inspect and maintain with much care the controller and associated electrical equipment of such machines. At one shop, however, this and certain other lessons were learned too late.

A planer in this shop had been doing a job which required that the bed stop immediately after the cutting stroke. Since this planer is driven by a d.c. motor quick stopping is secured by dynamic braking, the position and travel of the bed being determined by the setting of a limit switch. In conjunction with this switch is a master relay having an operating coil of rather high resistance, which consequently draws a very small amount of current.

One day while the planer was making the cutting stroke the bed failed to stop and the planer head, worth about $300, was broken. To determine the cause of this accident the planer was operated for long periods while the controller and other equipment was carefully watched, but everything worked perfectly. Eventually it was decided to rewire the controller as a precautionary measure, although the seat of the trouble had not been found.

Rewiring took almost two weeks and on its completion the planer was again operated for a considerable period to locate any defects. During one of these tests the bed again failed to stop and rolled off, narrowly missing an expensive drillpress.

An expert trouble shooter was then called in and after a thorough check of the controller, where he found only minor adjustments needed, he focused his attention on the limit switch. This switch had two contacts, one of bronze and the other of carbon—a combination that can be very troublesome at times. When the contacts were opened and closed repeatedly the resistance was found to be as high as 2,000 ohms on some readings. This increase in resistance resulted in failure of the master relay to operate, upon which dynamic braking depends.

The carbon contact was replaced with one of bronze and to date the planer has functioned normally.

Now the maintenance crew realizes the importance of more thorough-going inspections, and the necessity of looking for trouble even where they feel it is least likely to be found.

BUILDINGS, SERVICES, MAINTENANCE

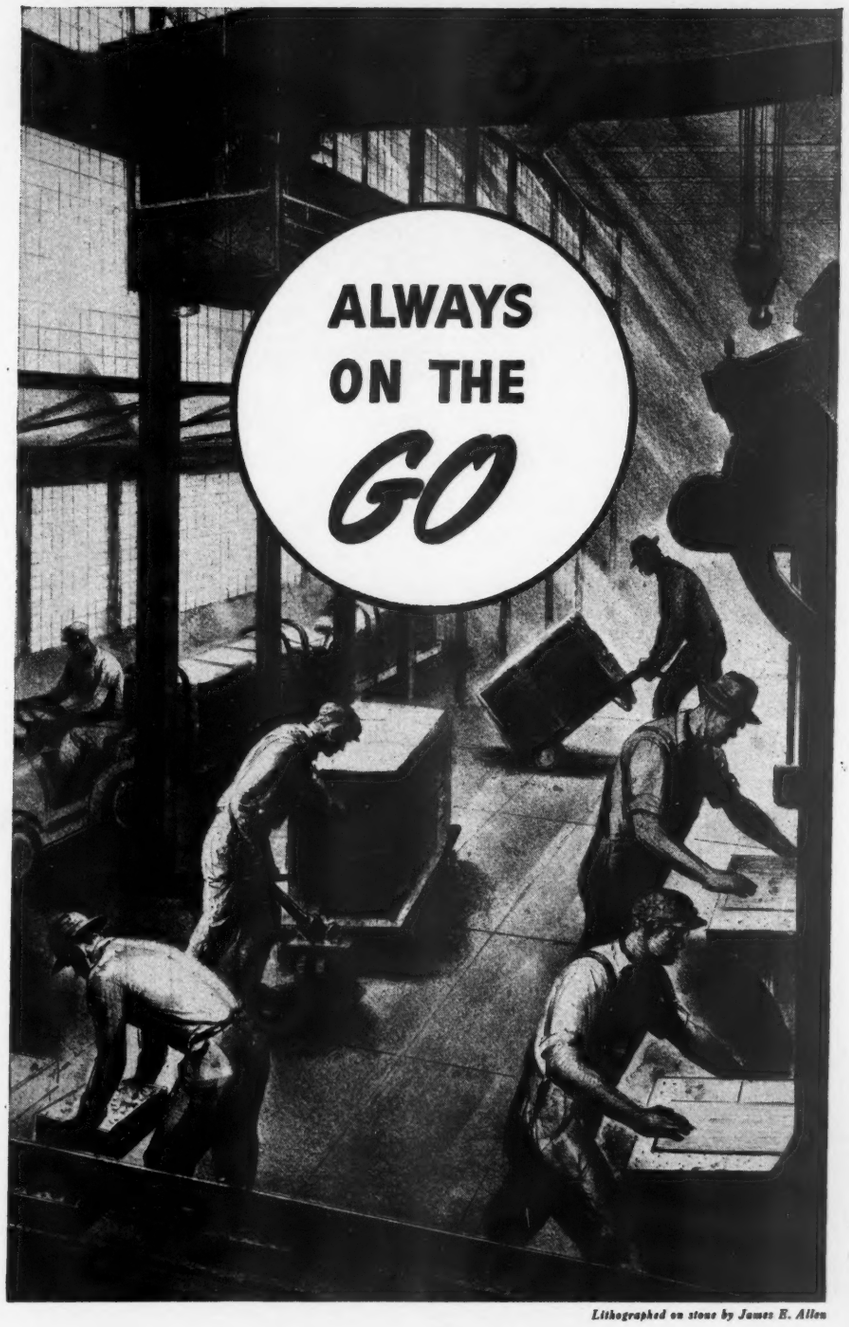
Pipe Crews Never Have to "Go Back for a Wrench"

SOURCE
Indianapolis Truck Engine Works
International Harvester Company
Indianapolis

Instead of taking pipe work to the maintenance department and then bringing it back to the production department for installation or replacement, pipe crews handle the work right at the site. For this purpose they have the two trucks shown in the illustration.

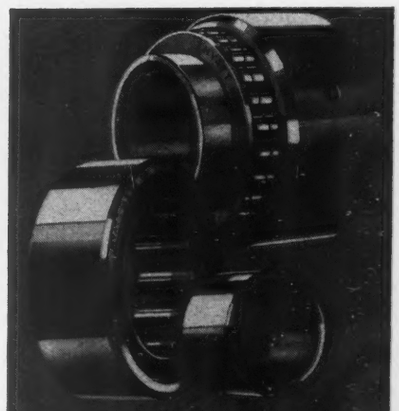
The trucks carry all of the tools and most of the necessary parts for repair work on lineshafts, countershafts, plumbing and steam fitting. The maintenance man does not have to "go back for a wrench" because his entire kit of

Pipe crew using portable pipe machine and combined portable tool box and work table



Lithographed on stone by James E. Allen

BECAUSE OF FRICTION-FREE HYATTS at vital operating positions, very little attention is required by the cranes, hoists, trucks, conveyors, etc. that handle materials around a busy factory. Hyatts bear the loads, conserve energy, smooth progress, lengthen equipment life. It's like that everywhere . . . in mill and mine; on highways, railways and farms . . . for dependable Hyatts handle their assignments with less wear and care! So be sure Hyatts are in the equipment *you* next build or buy. Hyatt Bearings Division, General Motors Sales Corporation, Harrison, New Jersey; Chicago, Pittsburgh, Detroit and San Francisco.



HYATT
ROLLER
BEARINGS

wrenches is always with him right there on the tool truck.

The vise on one truck has both grip jaws and pipe jaws, which is a handy feature. The other truck carries a portable machine for cutting pipe and threads.

This method of handling maintenance has been in operation ever since this plant was opened. It has proved to be far more efficient and in every way more satisfactory than the old method.

•

Laboratory needing small supply of cold water, lower than tap temperatures, and not wanting to use ice, installed a drinking fountain which it needed anyway. By tapping the fountain's reservoir they got the cold water.

•

Cool Rubber Mills With Spray Pond Water

E. F. SIBLEY
Chief Power Plant Engineer
Seamless Rubber Company, Inc.
New Haven, Conn.

We have a 400-ton refrigeration plant to provide chilled water for cooling rolls on rubber mills, and for air conditioning. As the chilled water had to be supplied to the plant 365 days a year it was difficult to make repairs, and the equipment was getting in bad shape. A city water connection supplied cooling water for emergency operation, but this cost around $60 a day and was not desirable for other reasons.

During fall, spring, and winter months our spray pond water could be made sufficiently cold for use in the plant. The pond was located on the roof five stories above the mills, static pressure was OK, no additional pumps were necessary, and piping was conveniently located so that a cross connection was quite simple. The total cost of providing spray-pond-cooled water to the plant was around $75, the greatest part of the cost being for two 6-in. gate valves.

The sketch shows the schematic arrangement. When refrigeration plant is in normal operation, valves *B* are closed and all others open. When we are cooling with the spray pond, valve *A* is closed and all others open. The only other change necessary is to switch the control on the chilled water pump from pressure regulating to maintaining a constant water level in the sump.

Since the connections were made we have operated almost eight months of the year on spray pond cooling. Power saving amounts to around $100 a month and we have plenty of time to overhaul the refrigeration equipment completely and keep it in top-notch shape.

•

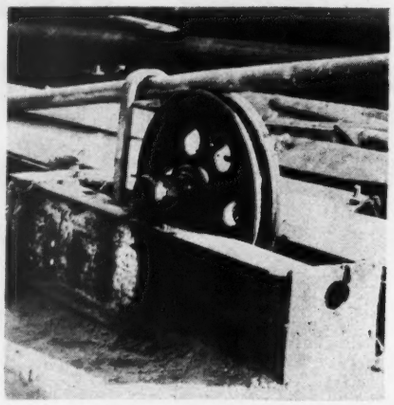
Straightener for Small Pipes

CHARLES C. LYNDE, *Kilgore, Tex.*

Pipe and tubing up to 2-in. diameter, unless thick-walled, can be straightened by hand. Where any amount of this work is to be done, as when overhauling heat-exchanger or condenser tubes, the work can be expedited and better results obtained with a device such as the one shown here.

On a solid base, formed from heavy channels connected by end plates, two half bearings support the shaft of a discarded sheave. A loop of heavy strap is welded to the base just beyond the pulley, and extending about to the level of the flange top.

A bent pipe, laid in the pulley groove and slipped under the loop, may be straightened by hand as the sheave revolves to permit spotting the bends. The curved faces of the flanges tend to distribute the straightening force over



more than the localized spot that would be affected were two fixed posts or pins to be used to hold the pipe while the necessary straightening force was applied.

Use of heavy channels for the base, while leaving the device portable, gives it sufficient weight so that it stays in place when set up near the job. Setting loop and sheave approximately level tends to position the pipe at the right height, so that the man at the high end can sight along the pipe without stooping or bending.

•

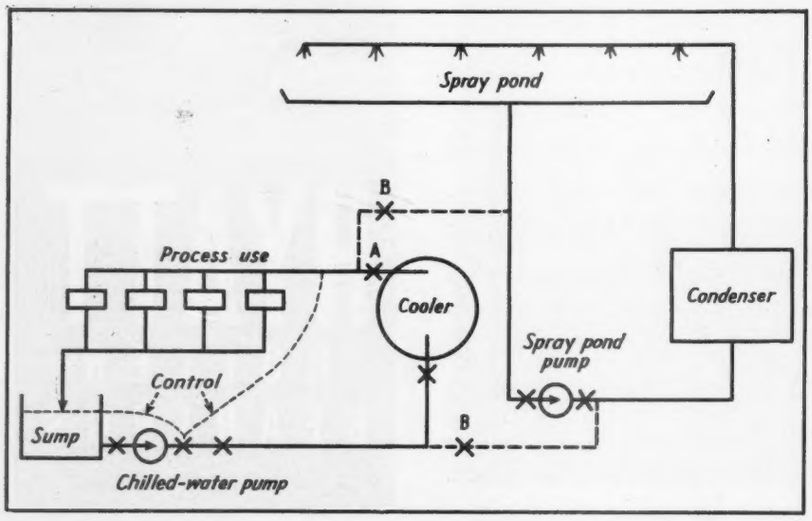
Resurfacing Saved Cost of New Floor

SOURCE
Stonnard Company
Philadelphia

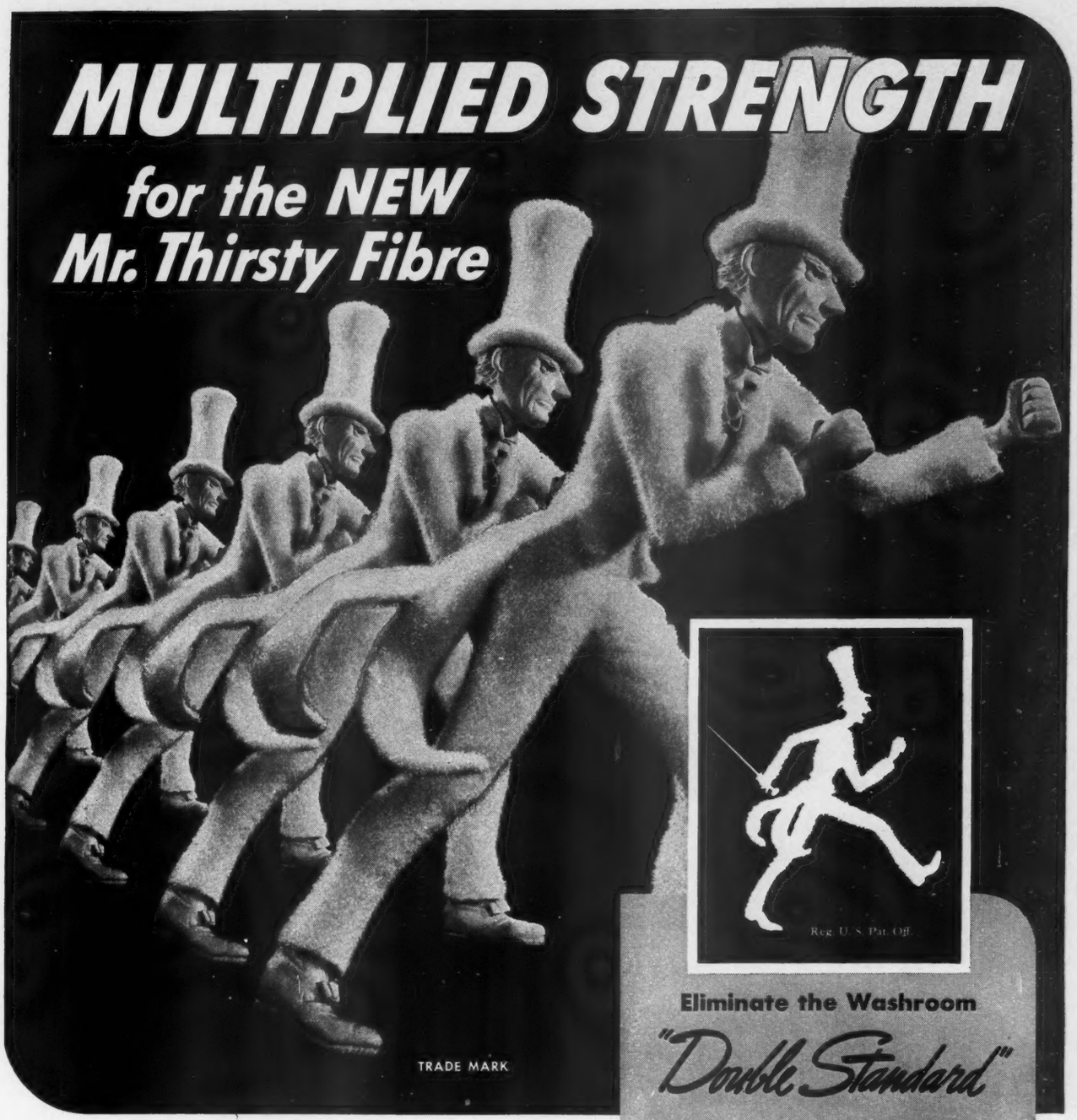
In an effort to waterproof a wood floor in a cannery, a membrane was placed between two layers of wood, thus preventing seepage to the floor below. After the floor had been wet and dried several times, however, it developed a noticeable tendency to warp and twist, which caused leakage and presented a poor surface for traffic and trucking.

The remedy that was eventually adopted for these conditions involved placing a layer of resurfacing material on top of the wood floor, without removing the membrane. In this way there was obtained a surface which is nonslipping, waterproof, long wearing, and fire-resistant.

The results which it has given have been entirely satisfactory.



MULTIPLIED STRENGTH
for the NEW Mr. Thirsty Fibre



NEW Soft-Tuff Scot Tissue TOWELS
ARE TOUGHER IN USE, YET AS SOFT AS EVER!

WHAT you want in a tissue towel is *softness*, combined with strength when saturated. Now, thanks to the Scott Duralose process, such a towel has been perfected. The new "Soft-Tuff" ScotTissue Towel is gentle to the touch—yet so tough it can be used up to saturation!

This extra strength means substantial savings. In economy tests, the new "Soft-Tuff" ScotTissue Towels have materially reduced previous ScotTissue Towel consumption.

The new "Soft-Tuff" ScotTissue Towels are now found in many great industrial plants, as well as thousands of offices, throughout the world. In fact, their use has increased approximately 40%! Let us demonstrate *to you* their unusual comfort and economy. Scott Paper Co., Chester, Pa.

Copr., 1940, Scott Paper Co. Trade Marks "ScotTissue," "Thirsty Fibre," "Duralose" Reg. U. S. Pat. Off. Trade Mark "Soft-Tuff" Registration applied for.

Eliminate the Washroom "Double Standard"

IN THE PLANT, workers appreciate these sanitary, individual towels. Since "Soft-Tuff" ScotTissue Towels are far tougher in use, one is enough . . . they cut waste.

IN THE OFFICE, executives enjoy the soft, luxurious quality of these new towels. Moreover, they are designed to eliminate lint being left on the face or clothing—an important advantage.

The Scott Washroom Advisory Service can help you arrange washrooms comfortably, hygienically and economically. It will suggest ways to improve traffic conditions, reduce waste and increase good will. Write for details.

Electrical Control Troubles and Their Causes

(CONTINUED FROM OCTOBER)

J. H. HOPPER
Industrial Control Engineering Department
General Electric Company
Schenectady, N. Y.

Table I. Types of Control Troubles and Their Causes

CONTACTORS, A. C.

A. C. Operated

Broken Pole Shader
(*a*) Heavy slamming caused by: overvoltage, weak tip pressure, wrong coil

Coil Failure
(*a*) Moisture
(*b*) Overvoltage
(*c*) High ambient temperature
(*d*) Failure of magnet to seal in on pickup
(*e*) Too-rapid duty cycle
(*f*) Corrosive atmosphere
(*g*) Chattering of magnet
(*h*) Metallic dust

Contact Tip Troubles (See Table II)

Failure to Drop Out
(*a*) Mechanical binding
(*b*) Gummy substance on magnet faces
(*c*) Airgap in magnet destroyed
(*d*) Contact tip welding
(*e*) Weak tip pressure
(*f*) Voltage not removed

Failure to Drop Out
(*a*) Low voltage
(*b*) Coil open
(*c*) Mechanical binding
(*d*) Wrong coil
(*e*) Shorted turns
(*f*) Excessive magnet gap

Insulation Failure
(*a*) Moisture
(*b*) Acid fumes
(*c*) Overheating
(*d*) Dirt on surfaces
(*e*) Voltage surges
(*f*) Short circuits

Miscellaneous Mechanical Troubles
(*a*) Overvoltage
(*b*) Heavy slamming caused by: overvoltage, weak tip pressure, wrong coil
(*c*) Chattering
(*d*) Abrasive dust

Noisy Magnet
(*a*) Broken pole shader
(*b*) Magnet faces not true due to wear or mounting strains
(*c*) Dirt on magnet

Pitted, Worn, or Broken Arc Chutes
(*a*) Abnormal interrupting duty (inductive loads)
(*b*) Excessive vibration or shock
(*c*) Moisture
(*d*) Improper assembly
(*e*) Rough handling

Wear on Magnet
(*a*) Overvoltage
(*b*) Broken pole shader
(*c*) Wrong coil
(*d*) Weak tip pressure
(*e*) Chattering

CONTACTORS, A. C.

D. C. Operated

Blowout Coil Overheats
(*a*) Overcurrent
(*b*) Wrong-sized coil
(*c*) Loose connection on stud or tip
(*d*) Tip heating (see Table II)

Broken Flexible Shunt
(*a*) Large number of operations
(*b*) Improper installation (check instructions)
(*c*) Extreme corrosive conditions
(*d*) Burned from arcing

Coil Failure
(*a*) Overvoltage
(*b*) High ambient temperature
(*c*) Wrong coil
(*d*) Moisture
(*e*) Corrosive atmosphere
(*f*) Intermittent coil energized continuously
(*g*) Holding resistor not cut in

Contact Tip Troubles (See Table II)

Failure to Drop Out
(*a*) Mechanical binding
(*b*) Gummy substance on magnet faces
(*c*) Airgap in magnet destroyed
(*d*) Contact tip welding
(*e*) Weak tip pressure
(*f*) Voltage not removed

Failure to Pick Up
(*a*) Low voltage
(*b*) Coil open
(*c*) Mechanical binding
(*d*) Wrong coil
(*e*) Shorted turns
(*f*) Excessive magnet gap

Insulation Failure
(*a*) Moisture
(*b*) Acid fumes
(*c*) Overheating
(*d*) Dirt on surfaces
(*e*) Voltage surges
(*f*) Short circuits

Miscellaneous Mechanical Troubles
(*a*) Overvoltage
(*b*) Heavy slamming caused by: overvoltage, weak tip pressure, wrong coil
(*c*) Chattering
(*d*) Abrasive dust

CONTACTORS, D. C.

Same as preceding

CONTACTORS, MANUALLY OPERATED

Contact Tip Troubles (See Table II)

Insulation Failure
(*a*) Moisture
(*b*) Acid fumes
(*c*) Overheating
(*d*) Dirt on surfaces
(*e*) Voltage surges
(*f*) Short circuits

Mechanical Failures
(*a*) Abrasive dust and dirt
(*b*) Misapplication
(*c*) Mechanical damage

CONTROLLERS, DRUM

Burning or Welding of Contacts and Shunts
(*a*) Shorts on control circuits with too-large protecting fuses
(*b*) Severe vibration
(*c*) Dirt
(*d*) Oxidation

Flashover
(*a*) Jogging
(*b*) Short circuits
(*c*) Handling too-large motor
(*d*) Moisture
(*e*) Acid fumes
(*f*) Dirt

Insulation Failure
(*a*) Moisture
(*b*) Acid fumes
(*c*) Overheating
(*d*) Dirt on surfaces
(*e*) Voltage surges
(*f*) Short circuits

Mechanical Failures
(*a*) Abrasive dust and dirt
(*b*) Misapplication
(*c*) Mechanical damage

Short Contact Life
(*a*) Jogging
(*b*) Handling abnormal currents
(*c*) No lubrication where recommended
(*d*) Abrasive dirt

FUSES

Premature Blowing
(*a*) Extra heating from outside

(CONTINUED ON PAGE 92)

Photo shows the Super-Diamond Pattern of "A.W." Rolled Steel Floor Plate. Provides safe tread from any angle, under any condition.

Making floors permanently safe . . . Here's an end to flooring problems. With "A.W." Rolled Steel Floor Plate, there are no worn and slippery surfaces to endanger men on foot. No cracks or ridges to upset floor trucks. Toughest traffic will not damage or impair it. Oil-proof, heat-proof, fire-proof, crack-proof. Easy to clean, quick to drain. Pattern is uniform and can be readily matched when additional plates are needed. For complete information on "A. W." Rolled Steel Floor Plate, write for folder.

ALAN WOOD STEEL COMPANY

MAIN OFFICE AND MILLS, CONSHOHOCKEN, PENNA. : : SINCE 1826 : : DISTRICT OFFICES AND REPRESENTATIVES—Philadelphia, New York, Boston, Atlanta, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, New Orleans, St. Paul, Pittsburgh, Roanoke, Sanford, N. C., St. Louis, Los Angeles, San Francisco, Seattle, Montreal—A. C. Leslie & Co. PRODUCTS INCLUDE—Steel Products in Carbon, Copper or Alloy Analyses : : Sheared Steel Plates : : Hot Rolled Sheets and Strip : : "A.W." Rolled Steel Floor Plates : : Billets, Blooms and Slabs : : "Swede" Pig Iron : : Reading Cut Nails.

Electrical Control Troubles and Their Causes

(CONTINUED FROM PAGE 90)

Table I. Types of Control Troubles and Their Causes

(*b*) Copper oxide on ferrules and clips
(*c*) High ambient temperature

Too-Slow Blowing
(*a*) Wrong-sized fuse for application

PUSHBUTTONS

Burning or Welding of Contacts and Shunts
(*a*) Shorts on control circuits with too-large protecting fuses
(*b*) Severe vibration
(*c*) Dirt
(*d*) Oxidation

Failure to Break Arc
(*a*) Too much current
(*b*) Too much voltage (usually d.c.)
(*c*) Misapplication
(*d*) Too much inductance

Failure to Make Contact
(*a*) Mechanical damage
(*b*) Dirt
(*c*) Corrosion
(*d*) Wear allowance gone

Insulation Failure
(*a*) Moisture
(*b*) Acid fumes
(*c*) Overheating
(*d*) Dirt on surfaces
(*e*) Voltage surges
(*f*) Short circuits

Mechanical Failures
(*a*) Abrasive dust and dirt
(*b*) Misapplication
(*c*) Mechanical damage

RECTIFIERS, DRY TYPE

Breakdown
(*a*) High temperature
(*b*) Moisture
(*c*) Overcurrent
(*d*) Overvoltage
(*e*) Corrosive atmospheres
(*f*) Mechanical damage

RELAYS, A. C., OVERCURRENT

Instantaneous

High Trip
(*a*) Mechanical binding
(*b*) Wrong or shorted coil
(*c*) Assembled wrongly

Low Trip
(*a*) Wrong coil
(*b*) Assembled wrongly

RELAYS, A. C., OVERCURRENT

Inverse Time

Fast Trip
(*a*) Fluid out or too light
(*b*) Vent too large
(*c*) High temperature

High Trip
(*a*) Mechanical binding
(*b*) Wrong or shorted coil
(*c*) Assembled wrongly

Low Trip
(*a*) Wrong coil
(*b*) Assembled wrongly

Slow Trip
(*a*) Fluid too heavy
(*b*) Vent too small
(*c*) Mechanical binding
(*d*) Dirt
(*e*) Low temperature

RELAYS, A. C., SIMPLE MAGNETIC

Blowout Coil Overheats
(*a*) Overcurrent
(*b*) Wrong-sized coil
(*c*) Loose connection on stud or tip
(*d*) Tip heating (see Table II)

Broken Flexible Shunt
(*a*) Large number of operations
(*b*) Improper installation (check instructions)
(*c*) Extreme corrosive conditions
(*d*) Burned from arcing

Broken Pole Shader
(*a*) Heavy slamming caused by: overvoltage, weak tip pressure, wrong coil

Coil Failure
(*a*) Moisture
(*b*) Overvoltage
(*c*) High ambient temperature
(*d*) Failure of magnet to seal in on pickup
(*e*) Too-rapid duty cycle
(*f*) Corrosive atmosphere
(*g*) Chattering of magnet
(*h*) Metallic dust

Failure to Drop Out
(*a*) Mechanical binding
(*b*) Gummy substance on magnet faces
(*c*) Airgap in magnet destroyed
(*d*) Contact tip welding
(*e*) Weak tip pressure
(*f*) Voltage not removed

Failure to Pick Up
(*a*) Low voltage
(*b*) Coil open
(*c*) Mechanical binding
(*d*) Wrong coil
(*e*) Shorted turns
(*f*) Excessive magnet gap

Insulation Failure
(*a*) Moisture
(*b*) Acid fumes
(*c*) Overheating
(*d*) Dirt on surfaces
(*e*) Voltage surges
(*f*) Short circuits

Miscellaneous Mechanical Troubles
(*a*) Overvoltage
(*b*) Heavy slamming caused by: overvoltage, weak tip pressure, wrong coil
(*c*) Chattering
(*d*) Abrasive dust

Noisy Magnet
(*a*) Broken pole shader
(*b*) Magnet faces not true due to wear or mounting strains
(*c*) Dirt on magnet

Pitted, Worn, or Broken Arc Chutes
(*a*) Abnormal interrupting duty (inductive loads)
(*b*) Excessive vibration or shock
(*c*) Moisture
(*d*) Improper assembly
(*e*) Rough handling

Wear on Magnet
(*a*) Overvoltage
(*b*) Broken pole shader
(*c*) Wrong coil
(*d*) Weak tip pressure
(*e*) Chattering

RELAYS, A. C., TIMING

Mechanical Escapement

Mechanical Wear
(*a*) Abrasive dust
(*b*) Improper application (in general not suited for continuous cycling)

Sticking
(*a*) Dirt
(*b*) Worn parts
(*c*) Improper adjustment
(*d*) Corrosion
(*e*) Mechanical binding

RELAYS, D. C., OVERCURRENT

Instantaneous

High Trip
(*a*) Mechanical binding
(*b*) Wrong or shorted coil
(*c*) Assembled wrongly

Low Trip
(*a*) Wrong coil
(*b*) Assembled wrongly

RELAYS, D. C., OVERCURRENT

Inverse Time

Fast Trip
(*a*) Fluid out or too light
(*b*) Vent too large
(*c*) High temperature

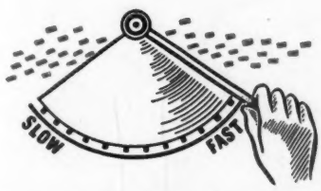
High Trip
(*a*) Mechanical binding
(*b*) Wrong or shorted coil
(*c*) Assembled wrongly

Low Trip
(*a*) Wrong coil
(*b*) Assembled wrongly

(TO BE CONTINUED)

FOUNTAIN OF YOUTH
—FOR OLD MACHINES

In the general speed up that American industry has undertaken, many manufacturers are finding a "fountain of youth" for old, slow-producing machines in the application of REEVES Variable Speed Control.



For REEVES Speed Control endows fixed-speed machines with the flexibility to handle more work, different kinds of work—and handle it far faster—than ever before.

Make no mistake—Variable Speed Control is not just a "crutch" on which production leans for support.

It is a complete system of production control and regulation, just as essential on brand new machines as on those which have been in service for many years. (Manufacturers of nearly 1,400 different machines, built for resale, incorporate REEVES Speed Control as standard equipment.)

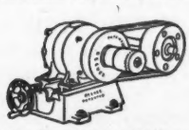
Our trained engineers are prepared to show you how REEVES equipment may be employed by you to prevent waste, speed up production and turn out a better quality product.

Look about in your plant today. See where work is accumulating because one or more machines cannot keep up. See other places where men are standing idle, waiting for work. Then write us. Tell us what kind and make of machine is falling down on the job, and let us make a recommendation of a REEVES SPEED CONTROL unit to cure the trouble. You'll be surprised how easily it can be done, and how little it costs.

REEVES PULLEY CO., COLUMBUS, IND.

WORLD'S MOST COMPLETE LINE OF VARIABLE SPEED CONTROL EQUIPMENT—BUILT AROUND THREE BASIC UNITS . . .

Transmission


Vari-Speed Motor Pulley

Motodrive

ACCURATE • POSITIVE
SPEED CONTROL

Reeves

This valuable, 124-page FREE book illustrates and describes scores of helpful installations. Write for it. REEVES PULLEY COMPANY, *Dept. F*, COLUMBUS, IND.

STOP LOSSES with METERS

Wherever valuable fluids are utilized in manufacturing or processing, accurate stock control is highly desirable. The surest way to maintain this control is through a system of metering. The meter system is the modern method of accounting for all movements of fluids through pipe lines. It largely eliminates the possibility of human error. A perpetual inventory may be maintained. Losses due to shortages, unauthorized withdrawals, or leaking pipes or tanks are quickly detected. Accurate cost records are made available.

A tanning firm has had 10 Pittsburgh Meters in service for several years. The Plant Engineer writes: "These solutions were formerly put in process by pails, but the meters have eliminated all this excess labor. We find that our product is more uniform since installing the meters since each batch of leather receives the exact amount of solution. As these solutions are very detrimental to practically all metals, we are pleased to advise that your meters are holding up in good condition."

There's a Pittsburgh Meter for every type of Service. Write for information about Pittsburgh Meters, and find out how to save money in the control of liquid stock in your plant.

●

PITTSBURGH EQUITABLE METER COMPANY

403 N. Lexington Ave., Pittsburgh, Pa.

You Want to Know

more about the items mentioned on this page. Letters to the addresses given will bring information

• ALUMINUM BRONZE can now be had as a coated welding rod for rebuilding worn cams, gears, dies, bearing surfaces, and for original work calling for a metal resistant to wear and corrosion. The new welding metal is said to rate higher in the Rockwell hardness scale than older bronze welding materials. Ampco-Metal, Inc., 1745 South 38th St., Milwaukee.

• FLEXIBLE STEEL RULE, 6 inches long, is marked in 16ths of an inch on one edge, 32ds on the other, and 64ths on the back. Can be turned from edge to edge without turning it end for end. Brown & Sharpe Mfg. Co., Providence, R. I.

• IF YOUR particular training problem includes welding as a needed skill, there's a booklet that should prove helpful, "Practical Lessons in Arc Welding," Part II of "Arc Welding and How to Use It." 50c. The Hobart Brothers Co., Hobart Square, Troy, Ohio.

• HOBBING TIME CALCULATOR, a slide rule for estimators, production managers, foremen, calculates "hob approach" for spur gears, spline shafts, and other straight forms, on one side. The other side utilizes that figure to arrive at the actual hobbing time. Barber-Colman Co., Rockford, Ill.

• ACCURACY to 8 millionths of an inch is claimed for a set of five toolmaker's and machinist's gage blocks measuring 1, 0.500, 0.250, 0.125, and 0.0625 inch. George Scherr Co., Inc., 128 Lafayette St., New York.

• AT THIS SEASON, when new automobiles are much in the mind and eye, an attractive little booklet which carries a "story of lighting from the primitive torch to the sealed beam handlamp" should find an interested audience. Copies of "Optics and Wheels" can be obtained by writing the Department of Public Relations, General Motors Corp., Detroit.

• MAIN QUESTIONS considered in pamphlet "If War Comes" concern the M-day plans of the War Department, the retention or loss of labor's recent gains, problem of taxing profits without stopping supplies. 10c. Public Affairs Committee, Inc., 50 Rockefeller Plaza, New York.

• SPRING WIRE is produced by passing sufficient electric current through the wire to heat it to desired quenching temperature. By employing this method to insure uniform heating, and by closely controlling heating time and quenching temperature, it is claimed that desired grain sizes and physical characteristics can be achieved with great accuracy. Jones & Laughlin Steel Corp., Pittsburgh.

• VIBRATION MEASUREMENTS can be made on a production basis, testing against "go" and "no go" limits, with an electronic instrument that can stand the hard usage that shop men are sure to give it. It is direct reading from one-thousandth inch to one inch, in four ranges. Televiso Products, Inc., 2400 North Sheffield Blvd., Chicago.

LABEL-GLUING MACHINE, hand-operated, applies glue or water to labels measuring up to 5½ inches wide. Reeded brass rollers apply the glue; wick-covered rollers moisten glued paper, envelope flaps, stamps. Glue-Fast Equipment Co., 30 West 15th St., New York

• PLASTIC RESIN ADHESIVE comes as a fine powder to be dissolved in cold water to form a permanent and waterproof wood glue. It sets by chemical action without a hardener, develops no fungus or rot, and since it is stainless, is valuable for use with rare woods, veneers, dyed materials. United States Plywood Corp., 616 West 46th St., New York.

• CHLORITE is a chemical that can be used in the basic processes of many large industries. It is especially useful in bleaching cotton, rayon, wood pulp, kraft paper without attacking the fibers; in bleaching in both acid and alkaline solutions; in cutting down the scouring and bleaching of textiles to one operation. Mathieson Alkali Works, Inc., 60 East 42d St., New York.

• TINY RESPIRATOR for nuisance dusts covers the nose only, can be carried in vest pocket when not in use, and wearer

"GULF PERIODIC CONSULTATION SERVICE . . . a Basic Plan for HIGHER LUBRICATION EFFICIENCY"

. . . say operating officials

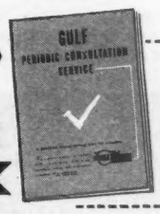
"MACHINERY has a bigger job to do today —modern machines are costlier but *more useful,"* say operating officials. "We need highly efficient lubrication to protect our machinery against wear and maintenance expense, and keep it in efficient, full-time operation."

That's why it is *real economy* to use Gulf's higher quality oils and greases. You can depend on GULF PERIODIC CONSULTATION SERVICE to insure a continuous check on lubrication efficiency, with the ultimate results — SAVINGS and PROFITS!

Gulf's higher quality lubricants are quickly available through more than 1100 warehouses in 30 states from Maine to New Mexico. Write or 'phone your nearest Gulf office today.

send for this Booklet →

GULF INDUSTRIAL LUBRICATION



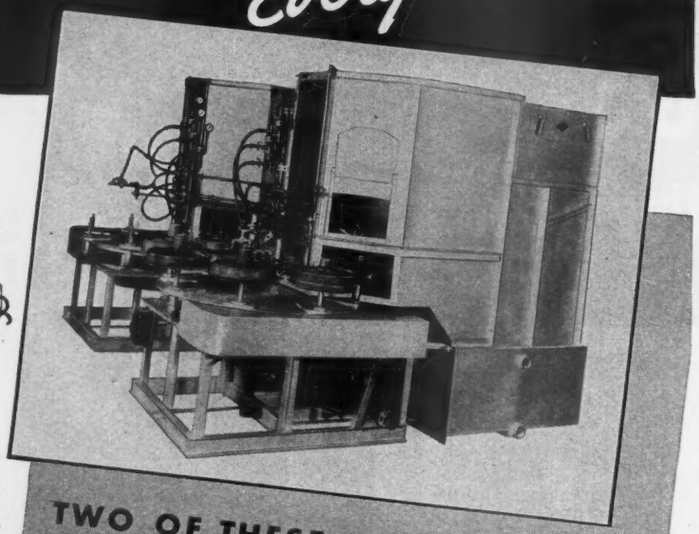
Gulf Oil Corporation - Gulf Refining Company F.M.&M.
3813 Gulf Building, Pittsburgh, Pa.
Please send me my copy — no charge — of the booklet "GULF PERIODIC CONSULTATION SERVICE."

Name.....

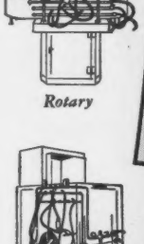
Company.....

Address.....

Saving $933.00 Every Month



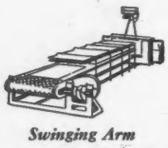
TWO OF THESE MACHINES PAID FOR THEMSELVES IN HALF A YEAR



Rotary

Pipe Coating

Horizontal Transverse



Swinging Arm

Heavy Duty Rotary

Gang Spray

• It's no mystery—it's DeVilbiss Automatic Spraying. These two machines paint 1,500 automobile hub and brake drum assemblies an hour.

What's Your Product? You may have a finishing or coating operation that DeVilbiss Automatic Spray Equipment can perform with equally profitable results. For among the standard DeVilbiss machines you'll find designs that can be adapted to any spray material on products of almost any size or shape—and do it better, faster, more economically.

Brake Drums or Lamp Shades? DeVilbiss Spray Machines automatically paint 200 feet of pipe a minute—spray 1,200 upholstery pads an hour—finish 3,500 fan parts an hour—tint 1,200 lamp shades an hour. But if you can't use automatic machines, take advantage of the speed and economy of new, modern DeVilbiss hand equipment.

Ask your DeVilbiss representative to show you how you can reduce your finishing and coating costs.

THE DEVILBISS COMPANY • TOLEDO, OHIO

Canadian Plant: WINDSOR, ONTARIO

THE COMPLETE DEVILBISS LINE CONSISTS OF: Spray-finishing equipment . . . Automatic coating machines . . . Tanks for spray materials . . . Spray booths and exhaust fans for vapor and dust elimination . . . Air regulators, cleaners and dusters . . . Air Compressors . . . Respirators . . . Specialized hose for paint, air, water, gasoline, welding and pneumatic tools . . . Hose connections . . . Water and oil guns . . . Equipment to prevent offset in printing . . . Paint stripers . . . Medicinal atomizers . . . Perfume atomizers.

DEVILBISS SPRAY SYSTEMS

can talk, eat, smoke, wear goggles with it on. The wafer-size filter is folded in such manner that 9 sq. in. of area are provided H. S. Cover, Chippewa A, South Bend,

• COST REDUCTION is the subject of three booklets, "Organizing for Cost Reduction," 75c., "The Foreman's Role in Cost Reduction," 75c.; "Personnel Aspects of Cost Reduction," $1. American Management Association, 330 West 42d St., New York.

• DISCRIMINATORY EFFECTS of present federal revenue act provisions regarding the capital goods industries, and recommendations for their correction, are discussed in a report on the results of a statistical investigation of federal tax laws. Machinery & Allied Products Institute, 221 North LaSalle St., Chicago.

• SOLE of an all-white rubber overshoe combines suction-squeegee action to make it non-skid on wet, soapy, oily surfaces. Practical in packing houses, dairies, creameries, garages. Industrial Products Co., 800 West Somerset St., Philadelphia.

WRITTEN MESSAGES, sketches, figures are sent over wire in facsimile to one or more stations, selectively or simultaneously, by a transmitter whose receiver or receivers may be nearby or miles away. Electric paper take-up and a starter switch automatically clear writing field of each message. TelAutograph Corp., 16 West 61st St., New York

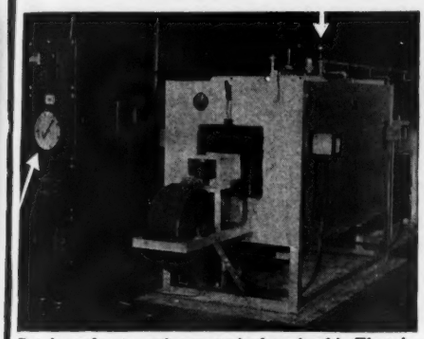
• "HOW NAZI GERMANY Has Mobilized and Controlled Labor" is a pamphlet whose information every loyal American probably can't and doesn't want to use. But for that very reason, because he doesn't want it to happen here, he will want to read of the methods employed in mobilizing Germany's labor resources in the gigantic war program, and the succession of steps by which German laborers have lost their freedom of initiative and action. 25c. The Brookings Institution, Washington, D. C.

• YOUR SAFETY EQUIPMENT can be augmented by an analyzer whose hypersensitive electric eye traces volatile solvents in air as low as one part in a million. Capable of two or three determinations a minute, it can be handled by a non-technical operator. E. I. du Pont de Nemours & Co., Wilmington, Del.

Brazing Furnaces Often Need "Rayotubes" To Hold Heat In Line

As those who use them know, controlled-atmosphere brazing furnaces can often do spectacular things in speeding up the assembly of metal articles. And it has been our privilege to have a hand in making some of these furnaces even more useful, by furnishing "Rayotubes" instead of ordinary thermocouples, for their temperature regulation.

The reason is that ordinary couples, in the "reducing" atmosphere of brazing, are apt to be unreliable. But a Rayotube, staring unwinkingly at the procession of white-hot parts, is not exposed to the furnace atmosphere. It stays outside the furnace, sealed against all gases. For that reason, it is continuously reliable for years and enables its Micromax Controller to do an outstanding job of temperature-regulation.



Brazing of automotive parts is done in this Electric Furnace Co. continuous belt-fed controlled-atmosphere unit. Arrows show Rayotube temperature detector and Micromax Recording Controlling pyrometer.

In the Electric Furnace Company unit shown here, for example, automotive parts are brazed together to form remote-control shift levers, clutch-release shafts, steering-knuckle-support arm brackets, and various other assemblies. Capacity is 250 lb per hr continuously; assemblies are joined about 60 per cent faster than by previous methods, and with about 75 per cent less labor. Performance is such that a second furnace of the same type and with the same Rayotube-Micromax control has been ordered.

Control To 5 Degrees

Temperature is set at 2050 F, and is actually held there to within plus or minus five degrees. Such close control would of course hardly be possible without uniform and careful loading of the furnace, but it would also be impossible without pyrometer equipment which can be relied on to hold its accuracy and responsiveness.

The same advantages which make the Rayotube-Micromax combination so effective for controlled-atmosphere furnaces also cause it to be used on a great variety of other furnaces where, for one reason or another, thermocouples are not satisfactory. If your plant has such a problem, we'll be glad to discuss it with you. In writing also ask for Broadside N-33 which gives a general idea of the types of instruments available.

General views of new heat-treating department, The Hale Fire Pump Co., Inc., Conshohocken, Pa., and close-up of work

Rejection-Free HEAT-TREATMENT

When Gears Are Homo Carburized & Tempered

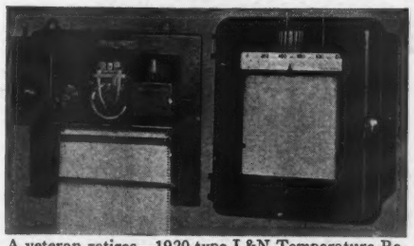
Heat-treating of gears for pumping engines was very noticeably improved by The Hale Fire Pump Co., Inc., when they started using a Homocarb furnace for hardening and a Homo furnace for tempering. These furnaces were brand-new to the Hale heat-treaters, but they enabled the men to apply their knowledge and skill, so that better results than ever before are being attained.

Specifically, hardness of gears is up 6 to 8 scleroscope points; uniformity of hardness is excellent and wearing qualities are substantially increased. Scaling, pitting and soft spots are entirely eliminated, and distortion is negligible, so that refinishing costs are considerably reduced.

And, if The Hale Company decides to carburize instead of harden, their Homocarb and Homo will continue to give them the same rejection-free heat-treatment. Uniform heating, uniform atmosphere, and convenient, fully-automatic operation make these furnaces ideal for either heat-treat operation.

If you have a heat-treatment problem involving furnaces, send us specific information or write for catalogs.

A "First" Potentiometer And Its Micromax Successor



A veteran retires—1920-type L&N Temperature Recorder and its replacement, a Micromax Pyrometer

Pyrometric control was just beginning to "get its growth" in the metal industries when the L&N Potentiometer Pyrometer shown here was built. It went, in 1920, to the Standard Steel Works Co., Burnham, Pa., now a division of Baldwin Locomotive Works.

From its worn condition, we gather this pyrometer delivered full service. And yet, it could go right back to work, if we still had replacements for a few of its parts. And the Micromax Pyrometers we supply today are even more dependable than this veteran, because the things we learn from instruments like this are applied in Micromax.

Its five models are described in Catalog N-33A.

Jrl. Ad ENT-0600C(5)

LEEDS & NORTHRUP COMPANY, 4909 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

REDESIGNING *One* CONTAINER SAVED MORE THAN THE SHIPPING MANAGER'S SALARY!

An eastern metal manufacturer found extra profit in the shipping room by sending several typical shipments to the General Box Laboratory for inspection. Each of the redesigned containers effected an important reduction in cost. For example, the hexagonal wirebound boxes shown above reduced tare weight by 24 pounds per shipment. Savings in container costs amounted to 16%. And adequate protection was provided. At the same time, easier, faster packing and handling was assured by the wirebound feature of these and other redesigned containers.

You, too, may find extra profits in scientifically designed shipping containers. Practically every type of product has received the benefits of General Box experience and laboratory facilities. Why not be sure of maximum economy? Mail the coupon today —there is no obligation.

GENERAL BOX COMPANY
General Offices:
504 North Dearborn St., Chicago, Ill.
District Offices and Plants: Brooklyn, Cincinnati, Detroit, Kansas City, Louisville, Milwaukee, New Orleans, Sheboygan, East St. Louis, Winchendon.
Continental Box Company, Inc.: Houston, Dallas

( ) Send complete information about the General Box Laboratory service.

( ) Have a General Box engineer call.

NAME_____

ADDRESS_____

CITY_____ STATE_____

What's New in Equipment

Refrigeration Condensing Unit

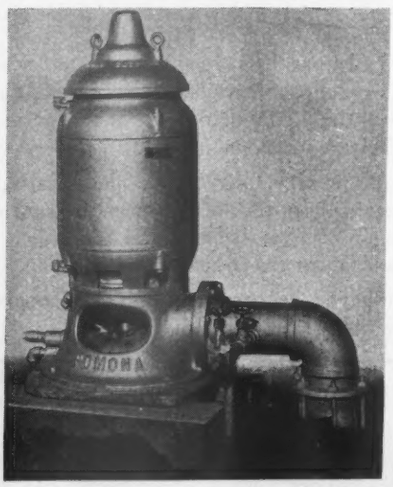
V-type refrigeration condensing units, both aircooled and watercooled, have vapor-cushioned valve of non-flexing type, forced-feed lubrication, replaceable shaft seal shoulder, oil-return check valve. Aircooled models are available in 2 and 3-hp. sizes, and the watercooled and evaporative condenser models are available in 2, 3, 5, and 7½ horse power. Carrier Corp., Syracuse, N. Y.

Electrical Connector

Type OPX Versitap is a connector that may be used as a parallel tap, a T-connector, a cross connector, or as an end-to-end connector. It will clamp a large range and combination of cable sizes in either the main or branch connection grooves. It is installed with a wrench and may be readily taped. Ten sizes accommodate cables from No. 8 to 1,000,000 circ.mil. Burndy Engineering Co., Inc., 459 East 133rd St., New York.

Vertical Turbine Pumps

Complete redesign of the line of 6-in., medium-capacity, vertical turbine pumps makes possible a capacity of 100 g.p.m. against 110-ft. lift in a well, and 50 lb.



pressure above, with a 7½ hp. motor, as against a 10-hp. motor with the old model. For this particular size pump and head capacity, efficiency is said to be increased 6½ points, the number of stages reduced one-fourth. Other features: The pumps are water lubricated with no stuffing box below ground level, semi-open impeller can be adjusted from surface for wear and changing capacity, non-sandlocking and non-gaslocking. The impellers made of bronze operate in a cone-shaped seat in the pump bowls. The Pomona Pump Co., 667 East Commercial St., Pomona, Calif.

Lift Truck

LT-40 handles 1,000 to 3,000-lb. loads in plants, mills, docks, warehouses, and terminals. Built on a 40-in. wheelbase, turning radius of 68 in., weighs 3,000-4,000 lb., has over-all width of 35 in. and over-all length (without forks) of 70 inches. Interchangeable attachments: Forks, rams,

scoops, flat plates, special loading devices. Powered by a 22-hp. 4-cylinder gas engine, equipped with degasser and governor, the LT-40 is said to travel at speeds 1-10 m.p.h. with 2 speeds forward and 2 reverse. Transmission has 4 gear elements. Said to be able to lift and stack its rated load 7, 9, and 11 ft. high at approximately 40 ft. per minute. Full-width upholstered seat is positioned in the center of the machine for comfort and safety. Motor assembly is under driver's seat. Towmotor Co., 1226 East 152d St., Cleveland.

Air-Hardening Die Steel

Improved alloy steel, Windsor Special, is a chromium-molybdenum-vanadium-type steel developed for use where the initial cost of the tool or die must be held to a minimum. It is said to be non-deforming, easily machined, tough, and to possess a wide hardening range. May be hardened and tempered in either oil or air. Jessop Steel Co., 527 Green St., Washington, Pa.

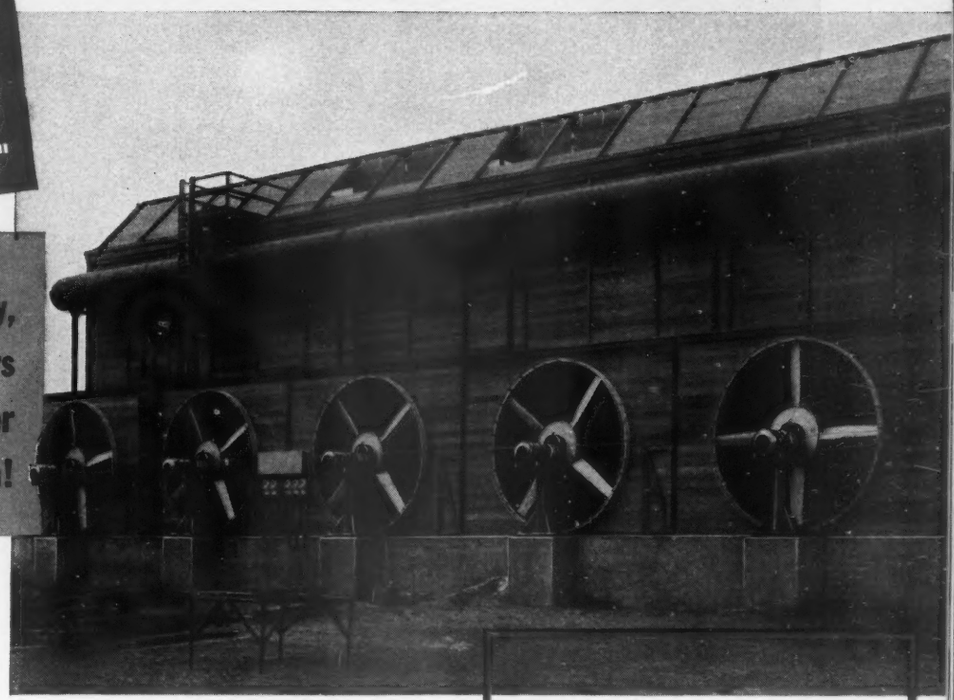
Liquid-Level Meters

Potentiometer transmission type, operated by float and cable mechanism in tank or reservoir, is adapted to applications where remote measurement of liquid level is required. Regularly furnished with

MAKES A CYCLONE WITH ALLIS-CHALMERS MOTORS!

Another true case history from the Allis-Chalmers files that proves **"IT PAYS TO BUY THE EQUIPMENT THAT PAYS FOR ITSELF!"**

Panhandle Power & Light Company, Borger, Texas, Finds Allis-Chalmers Lo-Maintenance Motors the Answer to a Tough Operating Problem!



MAKING a man-made cyclone to cool 15,000 gallons of water per minute is a job in itself . . .

But when it has to be done outdoors in all kinds of Texas Panhandle weather — in heat . . . in rain and dust storms . . . then you've got a situation that calls for motors that are *better* than ordinary.

Recently when the Panhandle Power & Light Company put in a Foster Wheeler cooling tower at Borger, Texas, they knew they were up against a tough operating problem. Here's how they solved it —

They went to their own customers in the carbon black industry where motor conditions were notoriously severe . . . found *one* motor in general use. And that motor, they discovered, to be the Allis-Chalmers dust-proof, weather-proof Lo-Maintenance Motor!

That's why they selected these same motors . . . why today they can snap their fingers at all the hazards of outdoor motor service in the Texas Panhandle. And best of all — they know they'll continue to get low-cost, dependable service for many years to come.

THE PANHANDLE POWER & LIGHT Company heard amazing stories from their customers about the performance of Allis-Chalmers Lo-Maintenance Motors. That's why they chose these same motors to power the four-bladed axial flow fans in their new cooling tower . . . where 15,000 gallons of water per minute are cooled from 105° to 90°F.

Cut Your Power Costs With Lo-Maintenance Motors!

For Allis-Chalmers Lo-Maintenance Motors are built with extra-value construction to give performance that's more than just their nameplate ratings. These motors are outstanding in having high carbon steel frame . . . indestructible rotor . . . distortionless stator . . . plus Allis-Chalmers famous no-stint policy in materials and workmanship!

Whether you have difficult or easy motor jobs, it will pay you to use Lo-Maintenance Motors. The trained engineer in the district office near you will be glad to tell you how you can cut power costs. Call him today. Or write Allis-Chalmers, Milwaukee.

A 1287

Over 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

A-C

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

HOW TO TELL A GOOD ROOF

28 Years Ago this J-M Asbestos Built-Up Roof was applied for the Kansas City Star, Kansas City, Mo. Today it's still giving excellent service with practically no cost for maintenance.

Compare the ordinary rag felt (left) with the J-M Asbestos Felt (right) after both were exposed to the same consuming flames. The rag felt was reduced to ashes but the J-M Felt came through unharmed. If you want to make this test yourself, we'll send you the samples.

A GOOD ROOF PROTECTS AGAINST FIRE

THERE'S no reason why you should ever worry about your roof being a dangerous fire hazard. With a J-M Smooth-Surfaced Built-Up Roof you get all the protection of ASBESTOS. Built up with felts of this fire-proof mineral, J-M Smooth-Surfaced Roofs can't contribute to the spread of fire. They form a seamless, stone-like blanket that repels fires from without... helps smother inside fires.

Yet fire-safety is only one of many advantages these better built-up roofs give you. Rot or decay have no effect on them. Because asbestos fibres are solid in construction (non-capillary), scorching rays from the sun can't dry out the felts. Records in our files show J-M Built-Up Roofs that are more than 30 years old still giving excellent service!

Why not investigate completely the facts that make J-M Roofs deliver more years of lower cost protection? Write Johns-Manville, 22 East 40th Street, New York, N. Y.

JM PRODUCT **JOHNS-MANVILLE**

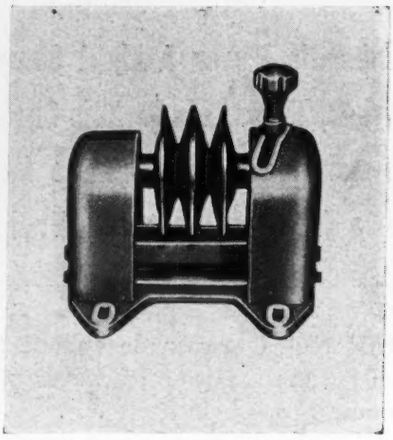
ASBESTOS **Built-Up Roofs**

The Roof with the Safety Factor

Style F transmitter, including pulley and gear reduction assembly, float chain and counterweight, 10-in. copper float, 12-in. diameter charts and ink supply. May be equipped with pressure and temperature recording elements or with high and low alarms. Current of 110 volts, 60 cycles, a.c. may be supplied at either transmitter or instrument. Range of level supplied to suit requirements. Two instruments may be connected to the same transmitter. Available for recording with integral indicator, for recording only, for indicating only, for recording with pen arm indicator. Cochrane Corp., 17th & Allegheny Ave., Philadelphia.

Variable-Speed Transmission

All-Speed V-belt-type transmission makes it possible to select right speed while machine is in operation. The speed selector operates on variable-pulley principle and consists of two interlocking pulleys mounted on a common shaft. The spindle



can be pivoted laterally between motor and driven machine to provide new running diameters on the interlocking pulleys. The selected speed is maintained by means of a locknut on the control quadrant. Oblique slot automatically guides the spindle to insure perfect belt alignment and increase belt life. Especially advantageous when control unit is mounted vertically. Designed for application where speed selection is vital to production, it has a wide speed range. Made in three sizes for ⅝-in. "A" and "B" belts, in speed ranges up to 12:1, ¼ to 1½ horsepower. Standard Transmission Equipment Co., Suite 330, 416 West 8th St., Los Angeles.

Diesel Electric Sets

Two models, the 88-41 and 77-34, are designed to be operated by personnel without special training. Both are powered by 4-cylinder diesel engines. The 88-41 has a bore of 5¾ in. and an 8-in. stroke. It develops 41 kw. at 900 r.p.m. when equipped with radiator fan, without fan kw. rating is 44. The 77-34 has a bore and stroke of 5¼ by 8 in., develops 34 kw. at 34 r.p.m. when equipped with fan, at 36 kw. without fan. Ratings are for the polyphase 60-cycle set. Single-phase ratings are lower. Self-controlled, the sets require a circuit breaker only. Inbuilt regulation enables them to

pick up relatively large motor loads with a minimum of light flicker and voltage drop. The three operating adjustments do not involve the fuel system. Generators are direct-connected, rotating field type, available as 3 phase or single phase, 60 cycle or 50 cycle, with a wide variety of voltages. Caterpillar Tractor Co., Peoria, Ill.

Enclosed Safety Switch

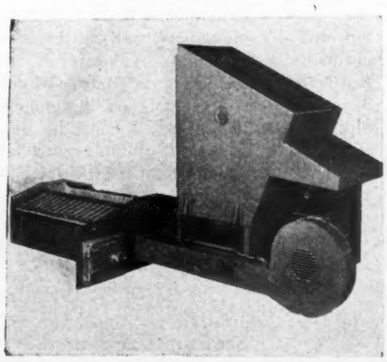
Type F-A front-operated enclosed safety switch, for either surface or flush mounting, is a heavy-duty industrial switch with quick make-and-break connections held under compression. Line and load connections are enclosed in an insulated shuttle. There is an arc-resisting barrier between line and load contacts at all times. Equipped with Kamklamp fuseholders for either ferrule or knife-blade types of fuse terminals. Available with or without an interlocking arrangement between operating switch lever and door of fuse compartment. Capacities: 30-200 amp. for 250 volts, a.c. or d.c., and 575 volts a.c. in 2, 3, or 4 poles. Switches are rated in horsepower. Frank Adam Electric Co., St. Louis.

A.C. Arc Welder

Power-factor correction is the main feature of a line of 500-amp. a.c. arc welders. This built-in feature is said to practically eliminate lagging current thus permitting use of smaller primary cable, line switches, and fuses, and the addition of more welders to existing feeders without causing overload. When operated below half load, this welder provides leading reactive kva. for improvement of the shop power-factor; when operated at no load, there is 19.5 kva. available for this purpose. Measures less than 4 ft. high, is 21 in. in diameter, weighs 600 pounds. General Electric Co., Schenectady, N. Y.

Anthracite Stokers

Utilize reciprocating ram blocks in the retort and reciprocating grates. Of the "poweram" underfeed type, Series 35



stokers are designed for high and low-pressure steam boilers, hot-water boilers. Nine sizes are available for loads ranging from approximately 24-140 boiler horsepower. Coal is burned on inclined reciprocating grates which gradually move the burning fuel from the retort toward the ashpit. Type CN and CW stokers have

HOW TO TELL A GOOD ROOFER

Sound Roof Construction demands outstanding roofing ability as well as the right selection of materials. Every J-M Approved Roofing Contractor is thoroughly trained and experienced in the J-M methods of roof construction that assure years of trouble-free service. He's the roofing expert in your community.

A GOOD ROOFER WELCOMES JOB INSPECTION

WHEN a craftsman is doing the best possible job, he's willing to have you question him about his work. And when a J-M Approved Roofing Contractor does work for you, he welcomes, in fact *wants*, your examination of the job. He's glad to show you exactly why he can give you a better built-up roof in every way.

Take flashing as an example. More leaks occur here through "short-cut" or inexperienced methods than at any other point on a roof. J-M Roofers know this and on every job follow carefully the rigid J-M Flashing Specifications that years of experience have shown are best.

The J-M Approved Roofing Contractor is the roofing expert in your community—a man chosen for his integrity and thorough knowledge of the built-up roofing business. For the name of the J-M Contractor nearest you, see your classified telephone directory, or write directly to Johns-Manville, 22 East 40th Street, New York, N. Y.

JOHNS-MANVILLE JM PRODUCTS

APPROVED Roofing Contractors

Selected for their Ability and Integrity

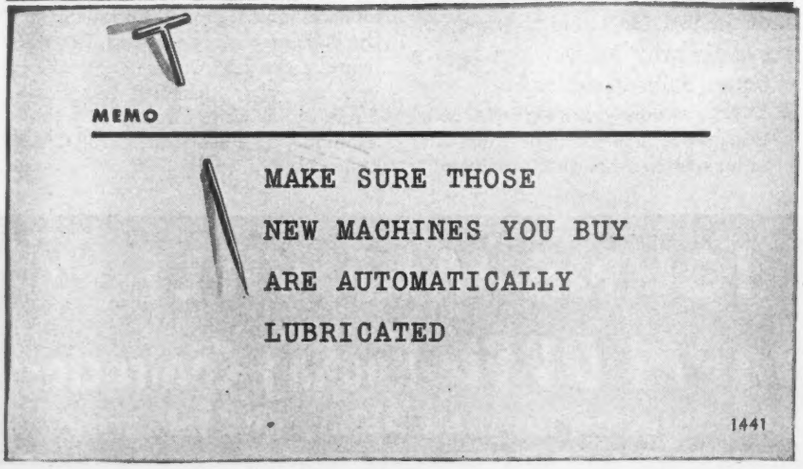
Safeguards ALL TYPES of bearings!
The correct oil film to each individual bearing... automatically
"Norton" Multipurpose Hydraulic Grinder
BIJUR
AUTOMATICALLY Correct LUBRICATION

● This machine is lubricated by a continuous film of clean oil metered to bearing surfaces of the table ways—in proportion to speed and extent of slide travel! Varying requirements of lubrication are met each instant . . . no mechanical adjusting necessary. Bijur equipment built into your machine will lubricate . . . correctly, unfailingly, automatically . . . any number of bearings of all types and sizes. Dismisses lubrication uncertainties!

Ask about BIJUR for your machines.

BIJUR LUBRICATING CORPORATION LONG ISLAND CITY, NEW YORK

1097



the retort in the center of the furnace with an ashpit on each side. Types SN and SW have the retort installed at one side of the furnace with a single ashpit. Air for combustion is supplied by a forced-draft fan through air ports in the grate bars which are graduated so that the coal is burned at a uniform rate and consumed before it spills into the ashpit. Ash is shoveled or hoed from pits through ash doors in the boiler front. Electric controls regulate the stoker. Motor: 1,725 r.p.m., 220-440 volts, 60 cycles, 3 phase, sleeve bearing. Standard hopper has 750 lb. capacity, 1,200-lb. hopper is available. Iron Fireman Mfg. Co., Portland, Ore.

Portable Air Compressor

For operating small spray painting equipment. Type NKB is rated at ½ hp. and is suited for interior and exterior

painting in factories, on automobiles, furniture, trucks, and buses. Said to be quiet in operation, weighs 72 lb., is equipped with 4 rubber-tired swivel casters, has delivery of 4.55 cu.ft. per min. at 45 lb. pressure, holds medium spray guns at 32-40 lb. while maximum pressure is 50 pounds. Available alone or with 4 different spray equipment assemblies. The DeVilbiss Co., Toledo, Ohio.

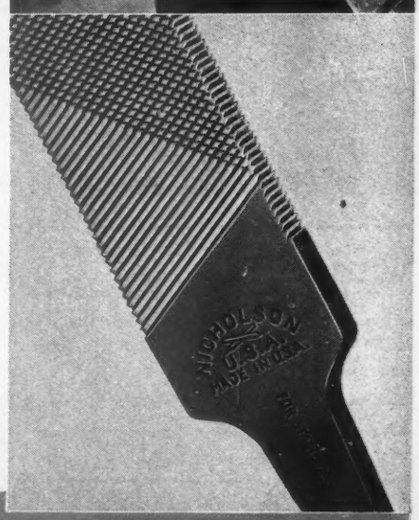
Automatic Timer

One hundred and twenty-eight models of interval timers and time delay relays are powered by slow-speed self-starting synchronous motors, and are equipped with fast-acting silver contact micro-switches. These all-electric controls are designed for electrical equipment which must be timed in split seconds, seconds, minutes, or hours. Manual or automatic reset models for built-in flush panel mounting, enclosed surface mounting, or wall mounting are available. Paragon Electric Co., 37 West Van Buren St., Chicago.

Sorting Rack

Sorting rack made from steel has many uses: Mail sorting; stationery storage; work organizing; order rack; trade magazine holder; stamp, paper, or tool storage. One of the features is a recessed bottom which permits racks to be securely stacked. Another is the hand-removable shelves which are adjustable every half inch. Rack

MASTERING ONE OF INDUSTRY'S TOUGHEST STEELS



Fast stock removal on thick-section stainless steel ▲

Smooth filing on thin-section stainless steel ▶

"For Stainless Steel" plainly stamped on tang ◣

EVERY advance in metallurgy opens up avenues for new products, or new standards in old ones. But with it come also new problems of production. Stainless steel, for instance. Difficult to machine, much of the burden of fabricating is thrown onto hand-filing operations. Even so, stainless steel is much too tough for ordinary general-purpose files.

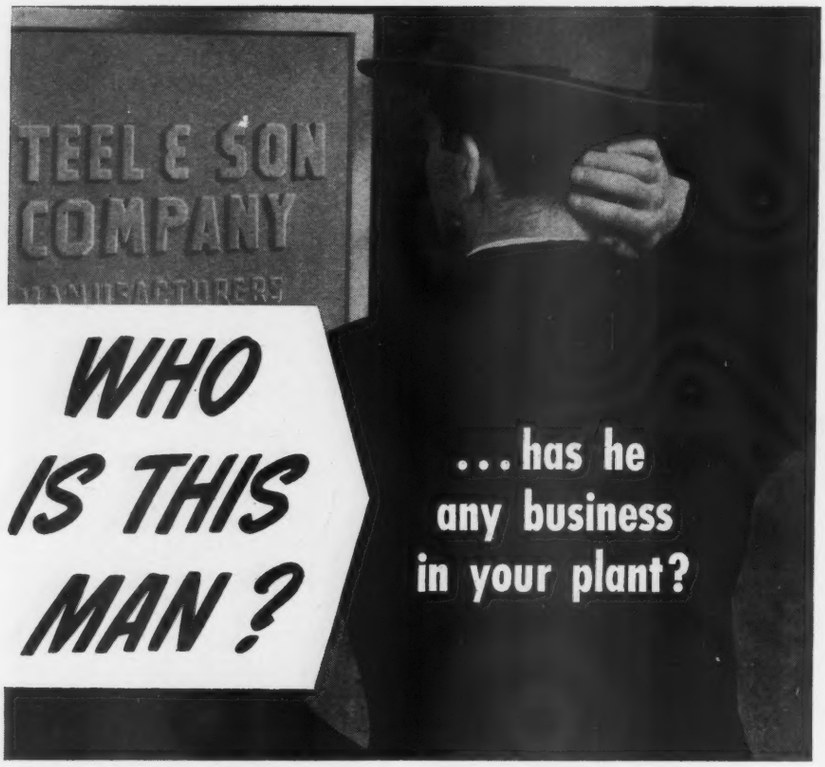
To combat the abrasive action of stainless steel's hard chromium carbides and nickel alloy, Nicholson's 76 years' experience in file making *exclusively* has produced for Industry a file with teeth-cut and wearing qualities unlike those of any other file. File efficiency is greater, and file costs are lower.

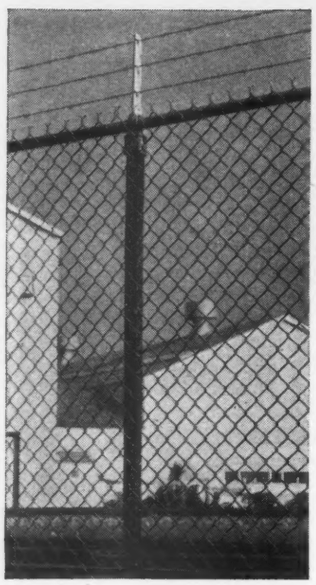
Yet this is just one of many special-purpose files which testify to the facilities of the world's largest file maker to provide *The right file for every job* under the famous Nicholson guarantee of *Twelve perfect files in every dozen.*

FREE TECHNICAL BULLETINS *to industrial managements on Nicholson or Black Diamond Stainless Steel, Brass, Aluminum, Foundry, Die-cast, Lathe Die-sinker's and other special-purpose files.*

NICHOLSON FILE CO., Providence, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON FILES FOR EVERY PURPOSE





ALL kinds of people walk by your plant, night and day. Among them may be thieves, snoopers or careless trespassers. The safest way to guard your plant from these undesirable people is with good fence — provided with conveniently located gates. Then your trusted watchmen can check everybody who comes in and every piece of material that goes out.

Most plant owners choose Cyclone Fence for this important protection job. Cyclone makes sturdy fence, strong enough to withstand a lot of punishment. All mesh, posts and other parts are galvanized to resist rust. And our factory-trained erection crews know how to build fence right. You can trust these men to do a good job.

You probably wonder what it will cost. We will gladly make a recommendation and an estimate without obligation to you. You'll find our prices right. We lead the field in sales, so our prices must be in line.

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Please mail me, without obligation, copy of "Your Fence—How to Choose It—How to Use It." I am interested in fencing: ☐ Industrial; ☐ Playground; ☐ Residence; ☐ Estate; ☐ School. Approximately.....feet.

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FREE! *32-Page Book on Fence*

All the facts you want to know about fence. 14 kinds illustrated. This book will help you choose the right fence for your property—business, school or home. Whether you need just a few feet of fence or miles of it, buy no fence until you see what Cyclone has to offer. Mail the coupon today.

USS CYCLONE FENCE
UNITED STATES STEEL

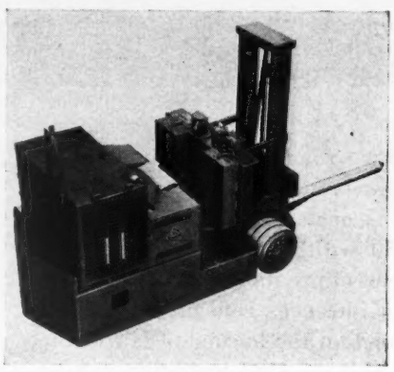
is equipped with nine 11⅛-in.-wide shelves and a full-width base to form 12 compartments. Each removable shelf has a label-holder. Each rack is 34⅛ in. wide, 11½ in. deep, 10⅝ in. high. The spot-welded steel construction is finished with a baked-on green enamel. Lyon Metal Products, Inc., Aurora, Ill.

Silica Removal From Boiler Feed Water

Process to prevent silica scale deposits in steam boilers, superheaters, and turbines makes use of silica-absorbing property of metallic oxide sludges. The water treated is brought into contact with high concentrations of sludge. Soluble by-products are not formed, it is said, therefore not increasing but usually reducing the total dissolved solids in the feed water. The process can be used in connection with hot and cold lime soda processes of water softening and is adaptable to new or existing equipment. The Permutit Co., 330 West 42nd St., New York.

Truck

The F-6 heavy-duty ram truck and gasoline fork truck, 16,000 lb. capacity, is built for tilting or non-tilting and for accommodation of ram, fork or up-ending devices. Steering is by means of a master control for motor-powered mechanism located at one side of operator's position in center of truck. Operator can see ends of fork

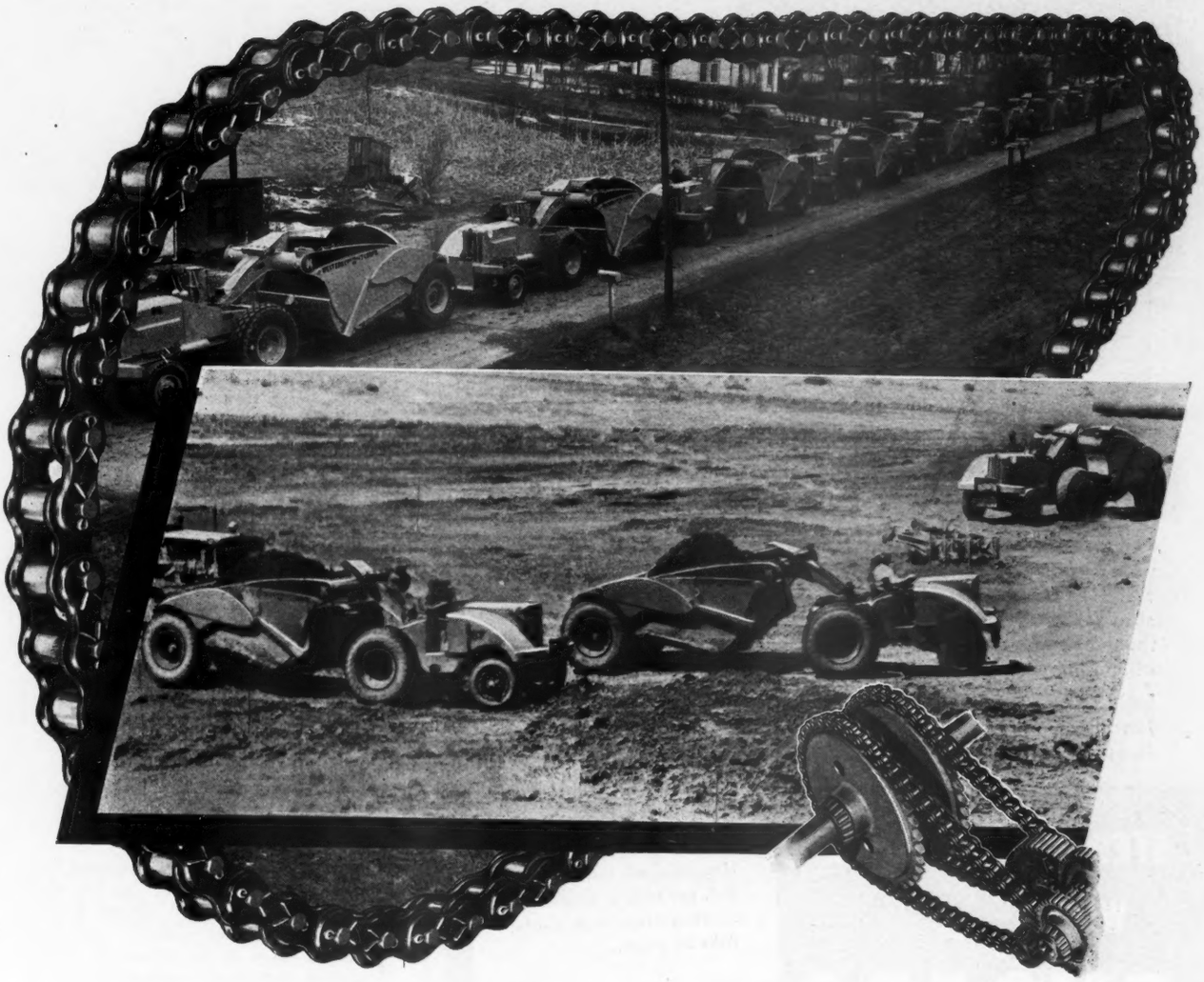


or ram when engaging the load. Heavy-duty motor drives front wheels through triple-gear reduction. Hydraulic brakes fitted. Tilt and hoist units are located between dash and load. Rubber pads are provided for the driver's seat. All-welded frame is ½ to one inch plate. Drive tires measure 22¾ by 18 in., trail tires (four) are 18 by 7 inches. The Elwell-Parker Electric Co., Cleveland.

Magnetic Starters

Across-the-line magnetic starters, for use with multi-speed squirrel-cage motors from 220-600 volts, 1-100 hp., are designed to start motors at any speed. Different speeds are obtained by changing connections to the motor so as to change its number of poles. Available for following types of multi-speed motors in 2, 3, or 4-speed types: Constant hp., constant torque, variable torque, single-winding motors, double-wind-

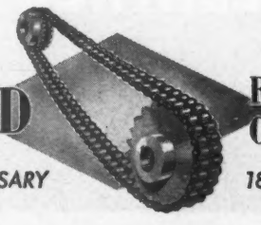
» AN ARMY OF SCRAPERS IS NO STRONGER THAN ITS DRIVE CHAINS



● Under their own power, 10 Koehring Wheeler Scrapers traveled 800 miles to tackle the job of moving three and one half million cubic yards of material around Caddoa Dam,—another example of the type of high-speed construction machinery America has available today.

These modern machines, like most of today's construction equipment, are designed and built with machine-tool-like precision—and are equipped with the kind of drives used by leading manufacturers of all types of modern machinery and in our most efficient plants—DIAMOND anti-friction Roller Chain Drives.

It is significant that such leaders standardize on DIAMOND for their power transmissions . . . Made for all speed ranges up to 4500 r.p.m., and in capacities up to 1200 H.P., DIAMOND Chain Drives in your plant and on your machinery will result in cost savings and increased production. Let us mail you our Drive Data Book. DIAMOND CHAIN & MFG. CO., 449 Kentucky Avenue, Indianapolis, Indiana. Offices and Distributors in All Principal Cities.



DIAMOND ROLLER CHAINS

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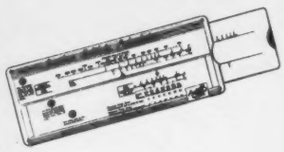
TANNATE Watershed Leather Belting offers you increased output at lowered cost per unit. Steady, uniform production is assured by the strong grip, long service life and unusual power transmitting capacity of TANNATE. Reduced maintenance expense and fewer 'times out' for repairs and replacements when your machines are equipped with TANNATE. Let TANNATE Watershed Leather Belting help you meet the needs of today's conditions — efficiently and with profit to you.

Let's talk about TANNATE in relation to your needs. Write. There is no obligation.



Get this handy leather belting calculator free. It is pocket size, calculates belt speed . . . H.P. per inch of belt width . . . determines belt width. Write for yours.

STEP UP PRODUCTION WITH

RHOADS

Founded 1702

Tannate

WATERSHED LEATHER BELTING

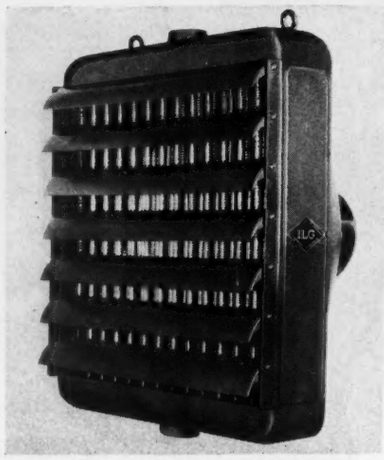
J. E. RHOADS & SONS · 35 N. SIXTH ST., PHILA., PA.

NEW YORK · CHICAGO · ATLANTA · CLEVELAND

ing motors. Features include pushbutton speed selection, overload protection, low-voltage protection, De-ion arc quenchers, front-of-board wiring with accessible terminals. Optional features: Selective speed control, compelled slow-speed start, automatic sequence acceleration and deceleration. Available in standard or dust-tight sheet-steel enclosures. Smaller sizes for Class II Group G and Class I Group D hazardous locations. Westinghouse Electric & Mfg. Co., Dept. 7-N-20, East Pittsburgh.

Unit Heaters

Line of Vital Zone unit heaters features a fully-enclosed self-cooled motor that "breathes," does not gum up from contact with foul air, nor "slow roast" due to radiated heat from the core. Second feature is a 2-piece header similar to that used in a high-pressure boiler. The header gives "balanced" steam distribution permitting the tubes to expand and contract uniformly. Top of the header is bolted on.



The heating coil is made of copper and consists of "wedded" tubes and fins with 26 gage fins flanged and pressed on the ⅜-in. outside-diameter seamless tubes for permanent union. At the bottom the header "floats" on slotted coil retainer and spring washers to allow for expansion and contraction of the coil independent of the unit casing. Eyebolts connected directly to the header provide independent safety suspension to avoid weight on the supply line. Capacity: Delivers 385-6,900 cu.ft. of air per minute shot out from 40-80 ft. depending on size of unit. Ilg Electric Ventilating Co., 2850 North Crawford Ave., Chicago.

Masonry Bolt Anchor

Two-piece unit, the Hammerset, consists of a sleeve and nut held together by taper friction. The sleeve is formed with one vertical slot, extending its length, which opens or closes according to diameter of hole in masonry. Can be used in bottomless holes, hollow tile, cinder concrete floors because the normal diameter of the sleeve which is greater than the nut contracts when driven into a normal hole locking the nut in position at desired depth. The tighter the bolt, the tighter the engagement with the masonry. Calking is said to be unnecessary—

"IT'S 9 TO 1 YOU'RE LOSING MONEY NOW"

Authorities agree that nine out of ten industrial plants in the country are in need of new wiring. Nine out of ten plants are losing money today through invisible power losses . . . power losses arising from antiquated, worn-out equipment, overloading or failure to provide adequate wiring for new equipment. Is your plant one of them?

Better check up now. Electrical failure... plant breakdown and consequent loss of output is even more expensive. Call in your maintenance man or electrical contractor and go over the problem of your plant's wiring. Better yet, ask us to send you our Industrial Wiring Survey and Industrial Wiring Guide. The Survey will tell you how to check your electrical circuits; and the Guide will show you what to do about the conditions you find.

Both are insurance against electrical failure . . . and whopping big repair bills. So, don't take chances... especially when those chances are 9 to 1 against you. Write for *free* copies of the Industrial Wiring Survey and the Industrial Wiring Guide now!

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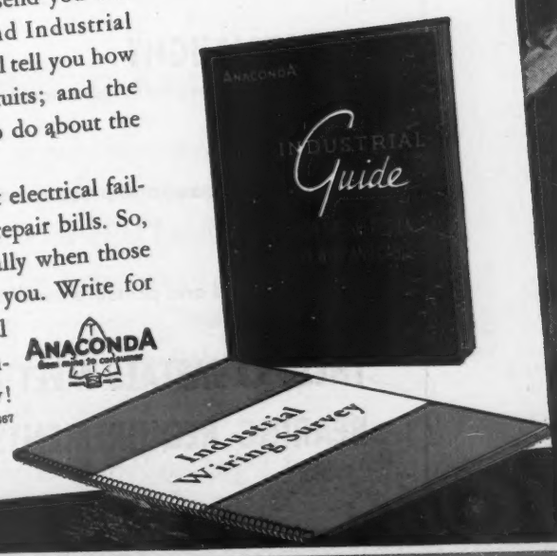

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—for low speed and pressure conditions

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EAGLE TIN-LOY is an ideal tinning compound that assures an effective lasting bond between bearing metal and the shell. Easy to use—efficient—economical.

THE EAGLE-PICHER LEAD COMPANY · CINCINNATI, OHIO

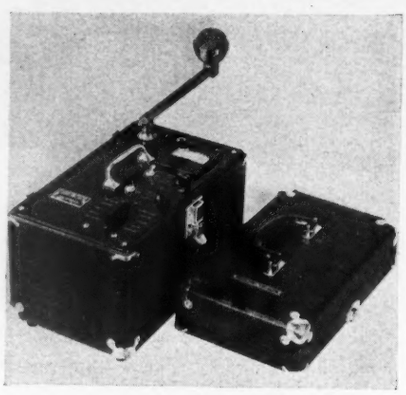
hammer blows do the job. When locked, the anchor is said to be unable to move vertically or horizontally. Sides are said to remain parallel with masonry wall regardless of position of nut or expansion of sleeve. The Rawlplug Co., Inc., 98 Lafayette St., New York.

Flexible-Shaft Angle-Head

Close-corner angle-head for use in drilling and filing with flexible-shaft machines has over-all dimensions from drill socket to top of case of only 2⅛ inches. Spindle center to outside of case is $\frac{5}{16}$ inch. Has aluminum housing containing two single-row ball bearings, back to back, on the vertical spindle, and a single-row ball bearing combined with needle bearing on the horizontal spindle. This construction is said to provide high thrust capacity. Accommodates drills and rotary files up to ¼-in. shank. For closer work, short drills with $\frac{1}{16}$-in. shanks may be inserted directly into the spindle and held by set screw. Stow Mfg. Co., Inc., Binghamton, N. Y.

Sound-Level Meter

Sound-level meter, 24-120 decibel range, weighs 19 pounds. May be used for almost any kind of noise study—airplane engine, traffic, motor, fan, generator, cylinder, gear, pump, bearing, turbine. Can be used for vibration measurement by substituting a vibration velocity unit for the microphone

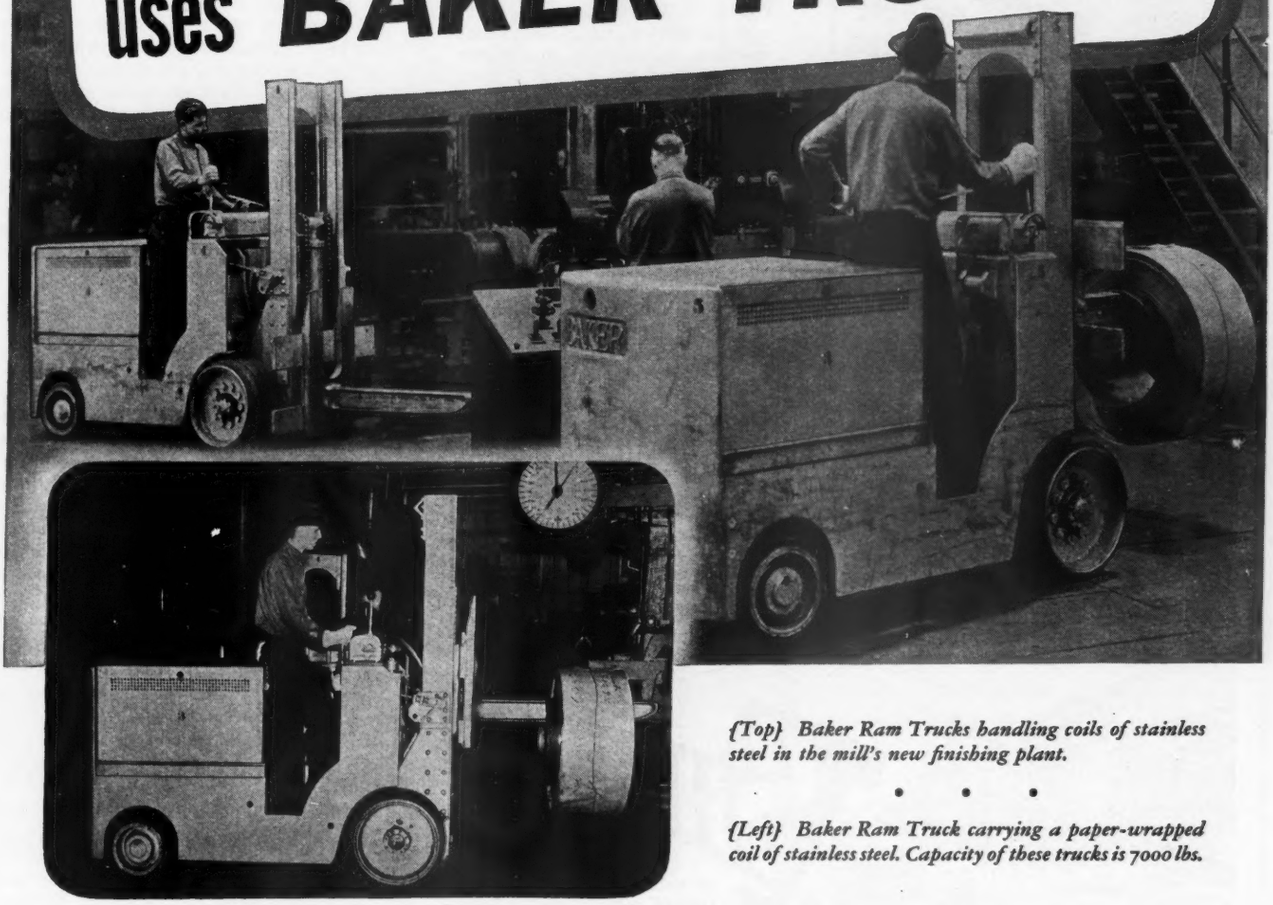


on the instrument. Essential parts are a microphone, amplifier, and indicating instrument. Switch permits selection of one or three ear-weighing networks, 40 decibels, 70 decibels, or flat frequency response, giving the instrument a response similar to that of the human ear, it is said. In field use a mouth-blown calibrating unit is applied to the microphone. After adjustment, a single knob does the controlling. Complete instrument is contained in a carrying case 12¾ by 7¾ by 9¼ inches. General Electric Co., Schenectady, N. Y.

High-Speed Scale

Aluminum super-speed scale built on the over-and-under principle has been designed to speed up the weighing process on production lines so that one scale can do the amount of work formerly done in a given time by two or three. Short lever fall and new flex movement are said to give it fast action and to reduce wear on bearings and pivots. The end position of

World's most modern stainless mill uses BAKER TRUCKS



{Top} Baker Ram Trucks handling coils of stainless steel in the mill's new finishing plant.

• • •

{Left} Baker Ram Truck carrying a paper-wrapped coil of stainless steel. Capacity of these trucks is 7000 lbs.

Modern Trucks Designed for Modern Handling Requirements

• The world's largest producers of stainless steel would naturally insist on the best of material handling equipment for their most modern mill. Their selection of Baker Trucks was dictated by experience with more than fifty Baker units already in service in their other plants. Determining factors were greater dependability, greater maneuverability, faster service and less time out for repairs.

If you have a material handling problem, why not let the experience of this great steel company also guide you to the right answer? Call your nearest Baker representative or write us direct.

BAKER INDUSTRIAL TRUCK DIVISION *of the Baker-Raulang Company*
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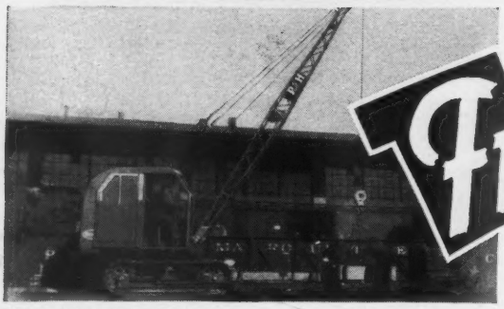
Baker INDUSTRIAL TRUCKS

● The speed and mobility of P&H Crawler Cranes, and the flexibility of their service, are making these machines as valuable to industry as P&H Overhead Electric Cranes.

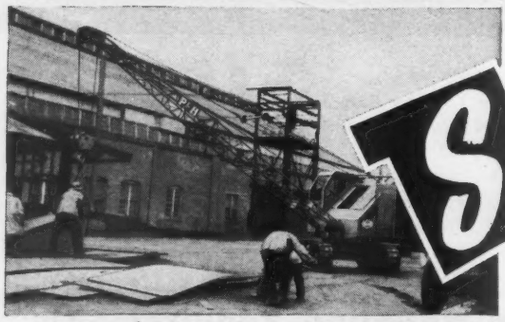
SCRAP

● P&H Crawler Crane handling scrap with magnet. Machine is easily and quickly converted for hook, sling or clamshell service.



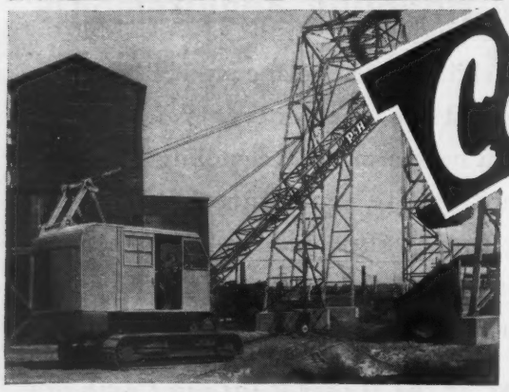
FREIGHT

● Loading and unloading gondolas—jobs are speeded up by the easy maneuvering of a P&H.



SHEETS

● Handling raw or finished materials. Smooth control permits accurate placing, stacking, etc.



COAL

● Unloading and transferring coal is done more efficiently when a fast-working P&H gets the assignment.

● P&H Crawler Cranes are built in a wide range of sizes and lifting capacities. If you have a yard or warehouse handling problem, write to us!

General Offices: 4525 West National Avenue, Milwaukee, Wisconsin

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CORPORATION
EXCAVATORS • ELECTRIC CRANES • ARC WELDERS P&H HOISTS • WELDING ELECTRODES • MOTORS

the tower makes for compactness and facilitates production-line use. Various scoops or commodity plates can be supplied to accommodate particular applications. Detecto-Gram Scales, Division of The Jacobs Bros. Co., Inc., Main Street, Brooklyn, N. Y.

Humidifier

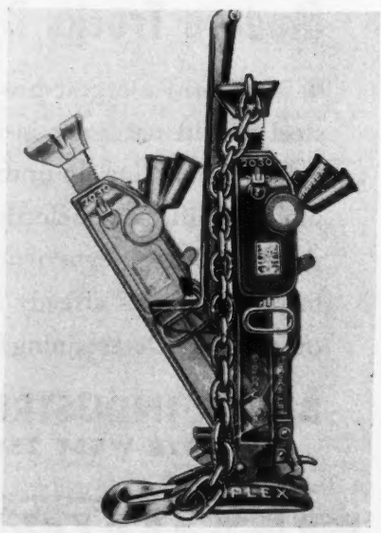
Features steel or wood cabinet which may be used in the office for an end table or stand. Said to circulate the air at about 200 cu.ft. per min.; to clean and wash the air by contacting surfaces over which water is constantly circulated; to remove smoke, dust, pollen. It absorbs odors and can be equipped with a device to infuse the air with disinfectants or perfume such as pine oil, oil of eucalyptus, or other scents. Said to use same amount of current as that required by 60-watt electric lamps. D.c. and 25 and 50-cycle models available. Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago.

Short-Interval Timer

Type T15, a universal timer, has been designed to permit complete interchangeability of equipment so that machine process calibrations for one timer apply to all timers. It is universal for 6 timing ranges represented by timing valves snapped into a clip. Control is accomplished through a snap-action relay of 1,000 watts capacity. Actuating control permits both momentary pushbutton and sustaining contacts control. Said to be very accurate over ranges from 1/20 sec. to 2 minutes. Photoswitch, Inc., 21 Chestnut St., Cambridge, Mass.

Heavy-Duty Emergency Jack

Model 2030 has a 20-ton lifting and holding capacity on either cap or toe lift of the jack. It also lifts on the auxiliary shoe which hooks into the cap or on the chain with grab hook end, any link of which



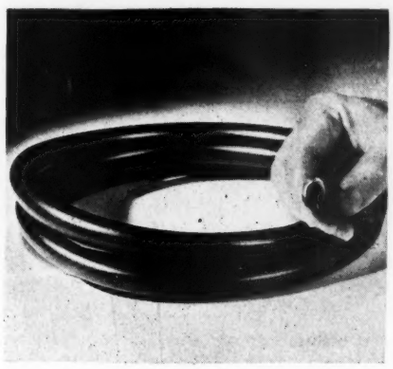
(Continued on page 117)

(Continued from page 112)

can be engaged with recess in the cap. The jack tilts on its base for jacking at an angle, the tilting pawl can be released by the operator's toe. Can be used horizontally for pushing, spreading, or pulling by using the chain. It is recommended for mines, skidding rigs, mills, construction and engineering projects using heavy machinery. Stands 30 in. high, has 17¾-in. lift, weighs 167 pounds. Templeton, Kenly & Co., 1020 South Central St., Chicago.

Synthetic Tubing

Hose made from Koroseal, a synthetic elastic material with rubber-like qualities, has no fabric or other wall reinforcement. Available in inside diameters ⅛ to ½ in., and wall thickness 1/16 to ⅛ in., and can be made in sizes up to 3 in. outside diameter. Recommended working pressure of 50 lb. per sq.in. is based on a safety factor of 5. Performance under certain conditions is



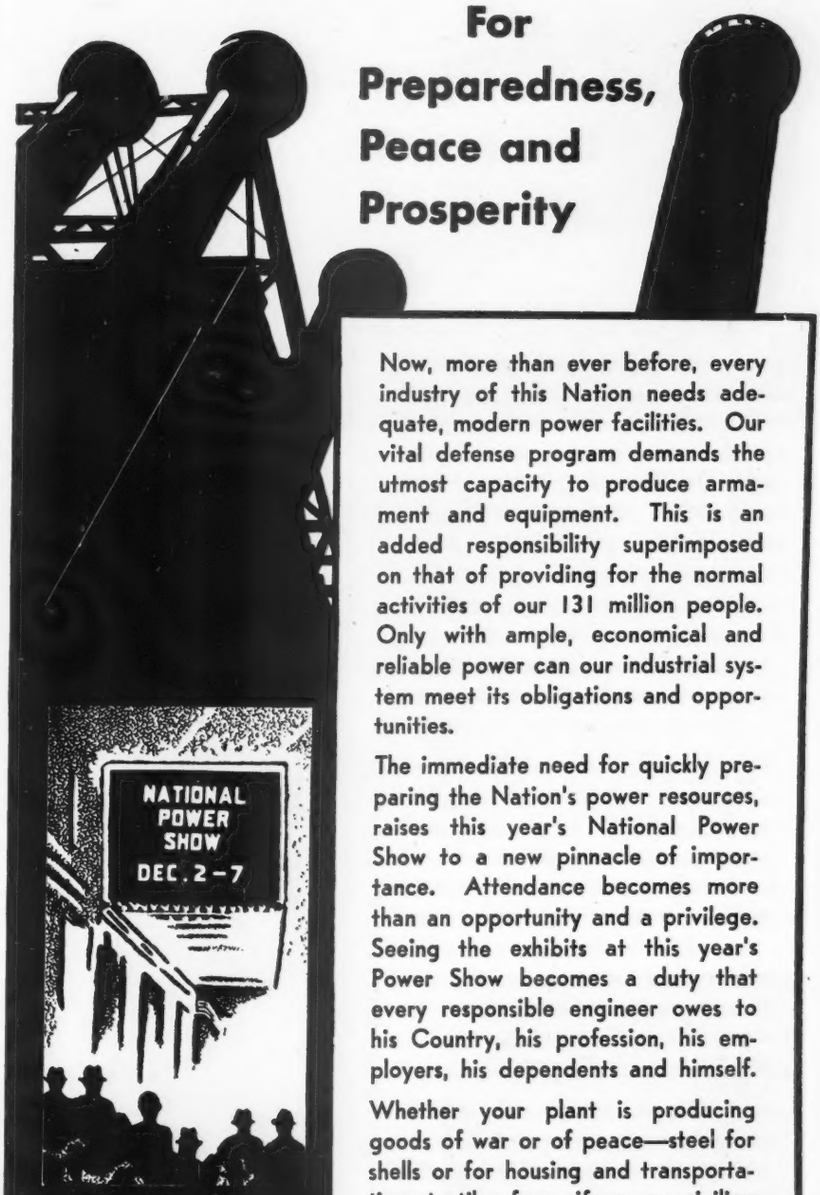
said to be better than rubber: Permits no loss of vacuum through diffusion; is free from sulphur so that it can be attached to brass, silver, other metals without corrosion of the metal; does not swell in oil and many other solvents of rubber; is not affected by strong corrosives; is practically impermeable to gas diffusion; does not absorb moisture. Is also said to be practically free from deterioration due to aging, ozone, or other oxidation. Should not be used in contact with food products, softens in temperatures above 150 deg. F. May be used in chemical laboratories and plants, as slip-on coverings for plating rack insulation, in electrolytic ore reduction plants, as friction roll coverings for business machines and recording instruments. The B. F. Goodrich Co., Akron.

Double "U" Packing

Reinforced hydraulic "U" packing, available in section sizes ⅛ to ⅞ in. inclusive for plunger diameter 9-90 in., is designated Double "U" because the wear wall and heel are doubly reinforced against wear on the contact leg and against pinch from excessive clearance between plunger and gland ring. The packing can be reinforced with any adaptable material over the "U" packing base. Standard reinforcement is chrome-tanned belting leather backed by oak-tanned belting leather. The packings are automatic in adjustment to pressure. The phosphor bronze spring spacer maintains light pressure against the inside of the beveled contact lip and near its pres-

MODERN POWER FACILITIES

For Preparedness, Peace and Prosperity



Now, more than ever before, every industry of this Nation needs adequate, modern power facilities. Our vital defense program demands the utmost capacity to produce armament and equipment. This is an added responsibility superimposed on that of providing for the normal activities of our 131 million people. Only with ample, economical and reliable power can our industrial system meet its obligations and opportunities.

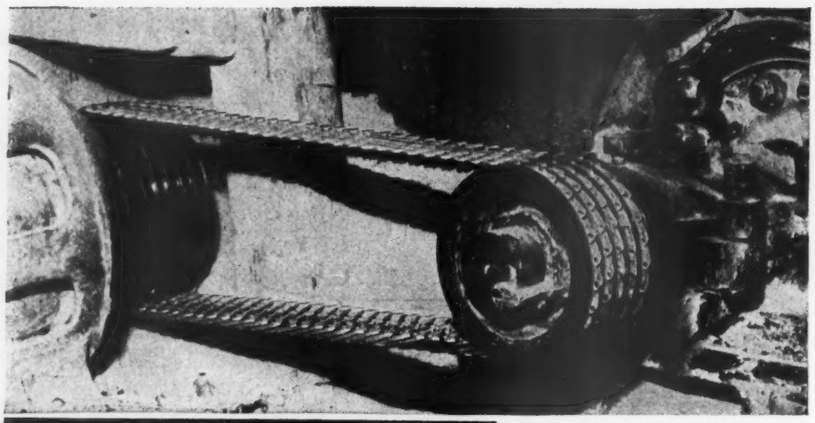
The immediate need for quickly preparing the Nation's power resources, raises this year's National Power Show to a new pinnacle of importance. Attendance becomes more than an opportunity and a privilege. Seeing the exhibits at this year's Power Show becomes a duty that every responsible engineer owes to his Country, his profession, his employers, his dependents and himself.

Whether your plant is producing goods of war or of peace—steel for shells or for housing and transportation; textiles for uniforms or civilian wear; food products, cosmetics, or paper for school books—come to the Power Show! See engineering's newest and finest aids to the generation and use of power for preparedness, peace and prosperity.

14th NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING

GRAND CENTRAL PALACE NEW YORK DEC. 2-7, 1940

Management, International Exposition Co.

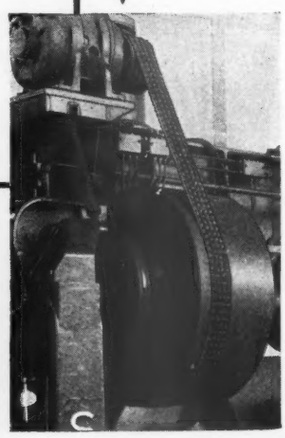


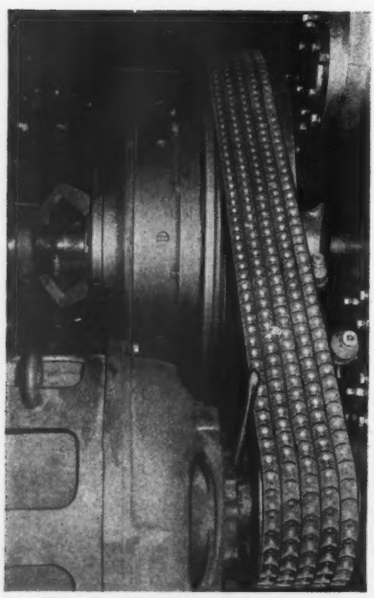
"We are having excellent results with Veelos V-Belting"

HUNDREDS of statements echo the above fact. By practically eliminating machine downtime for belt installation or repairs, by reducing slippage, by easy adjustability for equalizing tension or changing lengths, by virtually eliminating sheave wear—in a dozen different ways Veelos V-Belts are increasing machine efficiency over endless v-belts. Lower operating costs *and* greater production is the usual experience of those who have installed Veelos V. Let us give you factual evidence.

↑ "Veelos V-Belt Increases Motor Bearing Life," *writes G. & W. H. Corson, Inc. "Because they grip much better in the groove we need less tension on the drive. Also, with endless v-belts a damaged spot ruins the whole belt, while Veelos can be repaired by the replacement of a small section. This is a great asset."*

Four-Strand Veelos V-Belt *adds to the production capacity of this 3/8" x 158" Stamco Shearer built by Streine Tool & Mfg. Co., New Bremen, Ohio.* ↓





← 86% cut in machine downtime *for belt installation is the experience of the Merit Company, Chicago. They add, "We are completely convinced of the time and money saving possibilities of Veelos."*

VEELOS V-BELT

ADJUSTABLE to any length

ADAPTABLE to any drive

MANHEIM MANUFACTURING & BELTING COMPANY
MANHEIM, PA.

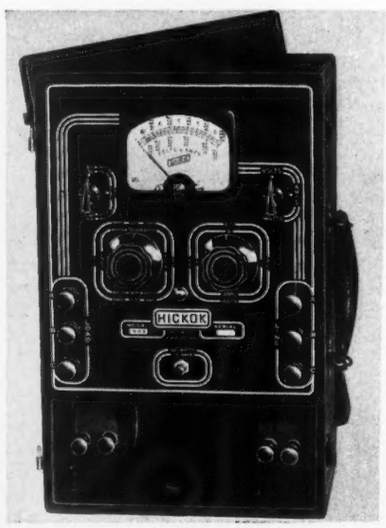
sure edge thus insuring a primary seal until the packing lips can be set to the plunger surface under pressure to carry the seal to the packing heel. The white oak spacer is steam bent to the packing channel forming the frame for the spring spacer. It extends beyond the packing lips and its contact with end of packing recess holds the "U" packing in position to seal at all times. The spacer cannot fall or float out, nor can the packing lips collapse, shrink, or curl when no liquid is present in the packing recess, it is said. Wayne Davies Packings, Inc., 325 West Huron St., Chicago.

Vacuum Cleaners

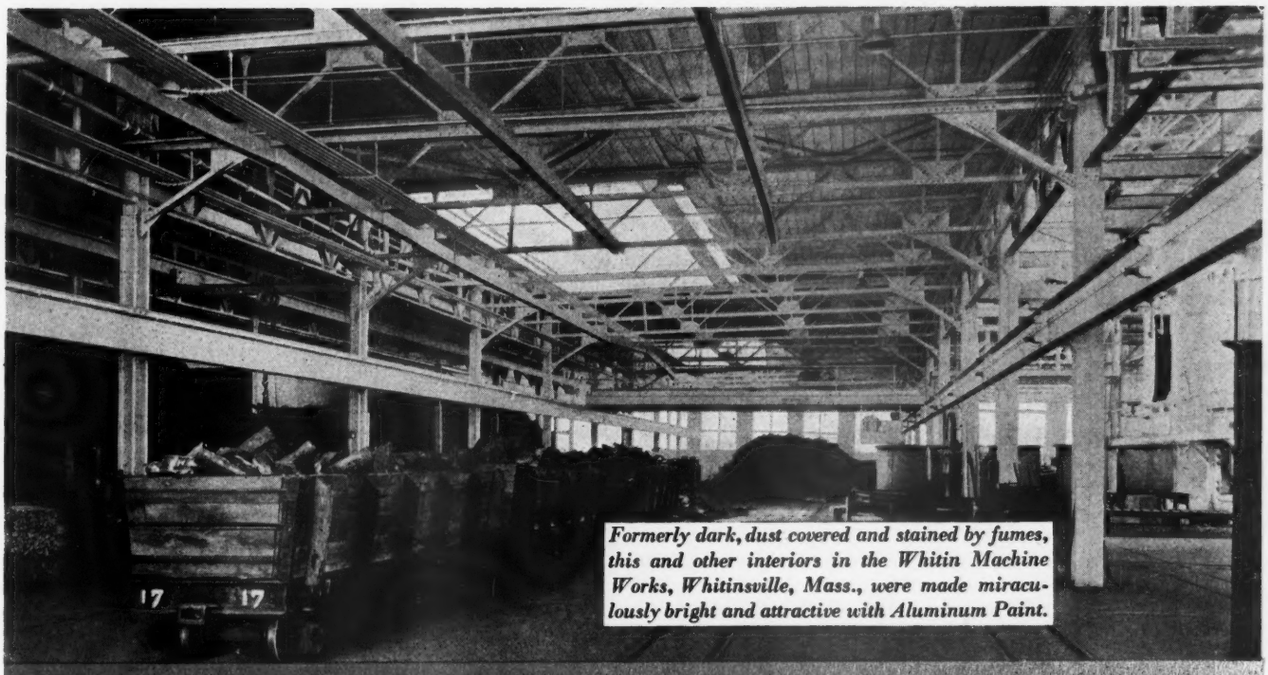
Two 1-hp. models, 184 and 184-A, are each equipped with a multi-stage suction fan, universal air-cooled motor, ball-bearings greased for life, four swivel-type ball-bearing casters, metal container provided with side handles for quick emptying. Dirt, dust, metal filings are taken directly into the container, and a special filter dries and cleans the air before it is exhausted from the tank. Container for Model 184 weighs 88 lb., and has filtering area of 1,475 sq. inches. Container for Model 184-A weighs 78 lb. and has filtering area of 1,220 sq. inches. Variety of tools for different cleaning jobs are available. Electric Vacuum Cleaner Co., Inc., 1734 Ivanhoe Road, Cleveland.

Power Analyzer

Universal power analyzer for electrical servicing measures polyphase and single-phase volts, amp., and watts. It can be used on single-phase 2 and 3-wire circuits and on 2 and 3-phase, 3-wire circuits. A rotary switch permits current measurement

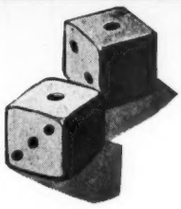


in any of 3 wires by inserting ammeter in desired circuit. Voltage can be measured across any 2 wires of a 3-wire circuit. Ranges up to 650 volts, 52 amp., 20,000 watts. Two multi-range current transformers are self-contained. Their ranges are selected by a 2-gang rotary switch controlled by one knob on the panel. Type C-104 transformers range up to 520 amp. and 200 kw., only one is required for single-phase 2-wire



Formerly dark, dust covered and stained by fumes, this and other interiors in the Whitin Machine Works, Whitinsville, Mass., were made miraculously bright and attractive with Aluminum Paint.

For life.. REMEMBER TWO THINGS ABOUT ALUMINUM PAINT



Don't gamble on the vehicle! There are vehicles and vehicles, prices and prices. Just remember that, no matter how good the pigment, it also takes a good vehicle of the proper type for the job to get the best results with Aluminum Paint.

Don't skimp on the pigment! Use a full two pounds to the gallon. And be sure those two pounds are top grade, high leafing Aluminum paste consisting of bright, thin, finely divided flakes to assure maximum coverage, good hiding, easy brushing and lasting reflectivity. In short, use two pounds of Alcoa Albron Paste.

Aluminum Paint of good quality stands on its record. Its durability and all around satisfaction are no longer open to question after the years of superior performance it has given on all sorts of industrial structures, plant equipment, and finished products.

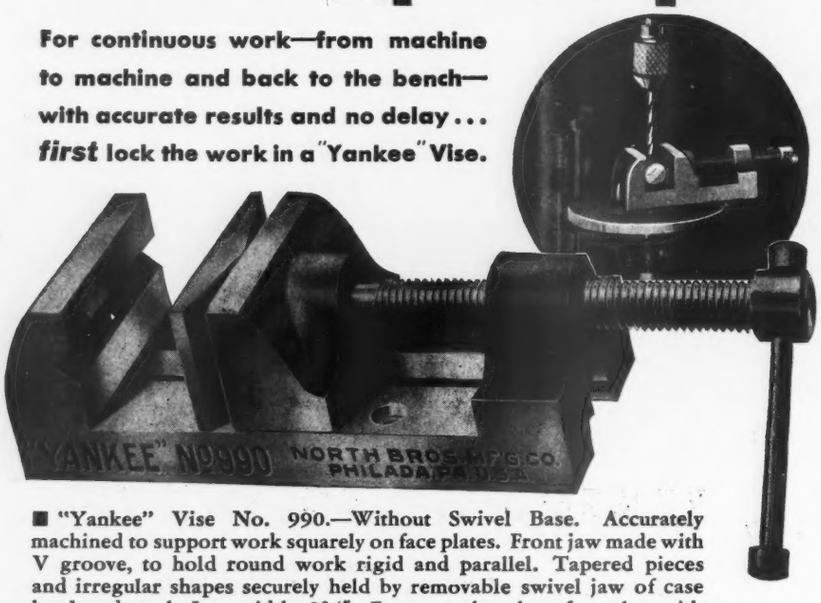
We make Aluminum pigments only; no Aluminum Paint. Aluminum Paint is furnished by leading paint companies who use Alcoa Albron Paste, which is manufactured under patents of Metals Disintegrating Co., Inc., by ALUMINUM COMPANY OF AMERICA, 2126 Gulf Building, Pittsburgh, Pa.

ALCOA ALUMINUM

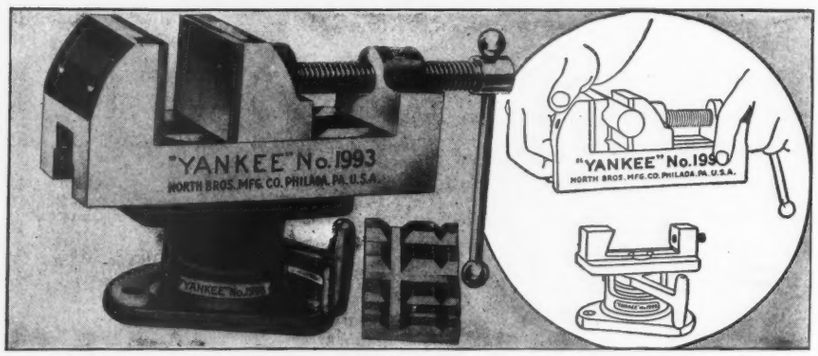
ALBRON *Paste for* ALUMINUM PAINT

"YANKEE" VISES stand by the job

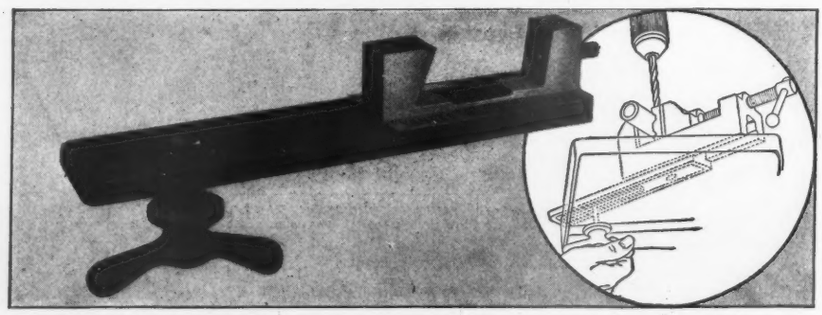
For continuous work—from machine to machine and back to the bench—with accurate results and no delay... *first* lock the work in a "Yankee" Vise.



■ "Yankee" Vise No. 990.—Without Swivel Base. Accurately machined to support work squarely on face plates. Front jaw made with V groove, to hold round work rigid and parallel. Tapered pieces and irregular shapes securely held by removable swivel jaw of case hardened steel. Jaw width, 2⅜". Fastens to bench or face plate with "C" clamp or screws. Not designed for use with "Yankee" Vise Clamp.



■ "Yankee" Vise No. 1993.—With Swivel Base. Accurately machined—sides, ends, base. Removable with work, from swivel base it carries the work in original alignment to drill press and other machines. Made in four sizes with swivel base: No. 1991, 1½" jaw width. No. 1992, 2" jaw width. No. 1993, 2¾" jaw width. No. 1994, 4" jaw width. (Same sizes, *without* swivel base.) Hardened steel block with V grooves, holds rounds.



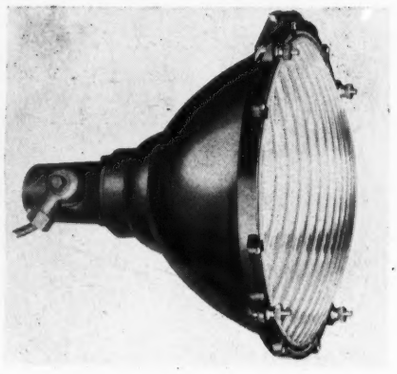
■ "Yankee" Vise Clamp.—Holds "Yankee" Vise securely to face plate. Gives rigidity and accuracy, for drilling and machining operations. Made in two sizes: No. 2992, for use with Nos. 992 or 1992 Vise. No.2993, for use with Nos. 993 or 1993 Vise.

ORDER from Mill Supply House. For "Yankee" Tool Book, showing time-saving tools, write North Bros. Mfg. Co., Dept. F, Philadelphia, U. S. A.

circuits, 2 are needed for all 3-wire circuits. The Hickok Electrical Instrument Co., 10328 Dupont Ave., Cleveland.

Local Floodlighting Unit

Designed to withstand vibration and corrosion, the Tufflite Concentrator uses either a 300 or 500-watt PS-40 Mazda lamp. The complete unit consists of a



copper housing, inner Alzak aluminum reflector, cast-bronze socket housing assembly, swivel for ¾-in. conduit mounting, glass cover door assembly. Hardware is bronze or copper, nickel plated. A heat-resisting glass spread lens is held securely in place against a graphitized asbestos gasket by 8 bronze spring clips fastened with machine screws. Ideal for use in railroad roundhouses, munition plants electroplating plants, breweries, around soaking pits, pickling vats, impregnating tanks. Westinghouse Electric & Mfg. Co. Dept. 7-N-20, East Pittsburgh.

Sectionalized Motor Control

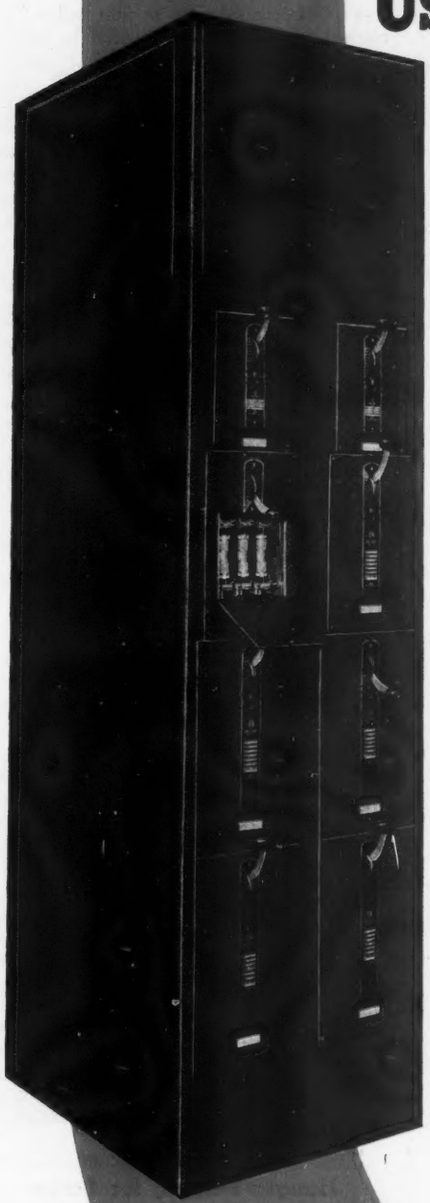
Unitrol, built on the principle of sectional filing cabinets, permits control devices to be organized in locker-like motor-control centers instead of by the pillar-and-post method of mounting. Makes for flexibility and quick building up of the control center and facilitates layout changes and remodeling. The motor control units are mounted in standardized cubicle sections available in 32 sizes, 8 widths, 4 heights, one depth for mounting any desired combination of units—can accommodate controllers, disconnect switches, circuit breakers, accessories. Units may be mounted in front and rear of the section; the sections may be installed in a straight line, an L-shape, a U-shape. Units are assembled either with all wiring buses, supports, terminals, and interconnections already made, or with provisions for wiring on the job. Black steel panels are furnished for unused sections. Cutler-Hammer, Inc., 315 North 12th St., Milwaukee.

Unit Heater Control System

System of unit heater control provides for modulated continuous control of steam whenever thermostat is calling for heat—the quantity of steam flow being dependent

Use (FA) Shutlbrak Switches

singly—or in compact panelboard or switchboard . . . . .



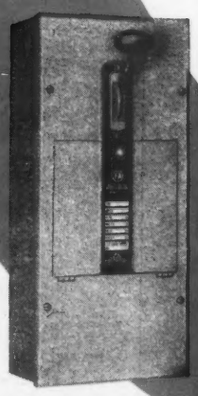
This new safety-type, one-piece-panel switchboard is ideal for service entrance, motor control, and other power and light distribution installations. Designed to occupy a minimum of space, each steel panel is self-contained, with all of the switch units connected to the busbars of that section. Each switchboard panel unit is individually enclosed, with a junction box built into the top of the panel. Any number of the switchboard panel units may be joined side by side, or otherwise arranged to fit available space.

The (FA) Shutlbrak Switch

of which these switchboards and panelboards are assembled, is a heavy duty industrial switch, front operated. *It embodies entirely new ideas in both design and construction* . . . Its quick make and quick break connections are *held under compression*, which reduces heating to a minimum . . . The line and load connections are enclosed in a completely insulated shuttle, which contains the movable contacts. There is an arc-resisting barrier between line and load contacts *at all times* . . . All contact surfaces are silver-plated, to prevent oxidation . . . The switch is available either with or without an interlocking arrangement between the operating switch lever and the door of the fuse compartment . . . Capacities at present: 30 to 200 amp. inclusive, for 250 volts AC or DC, and 575 volts AC, in 2, 3 and 4 poles. (Larger capacities in preparation.) Each switch is rated in horsepower. Approved by Underwriters' Laboratories as an Enclosed Switch.

For More Complete Information

write for Bulletin 59. (FA) Sales-Engineers will be glad to help you with your electrical engineering problems — without obligation. Write for name and address of the one nearest you . . . Frank Adam Electric Co., St. Louis, Mo.



Switchboard Panel Unit above has 2—60 amp., 2—100 amp. and 4—200 amp. switches in a 28" width.

The switch-box has ample room at top, bottom and behind the switch unit for wiring and connecting space. It may be had for either surface or flush mounting.

EST. 1891 THE SIGN OF A BETTER JOB

FA

Frank Adam

ELECTRICAL PRODUCTS

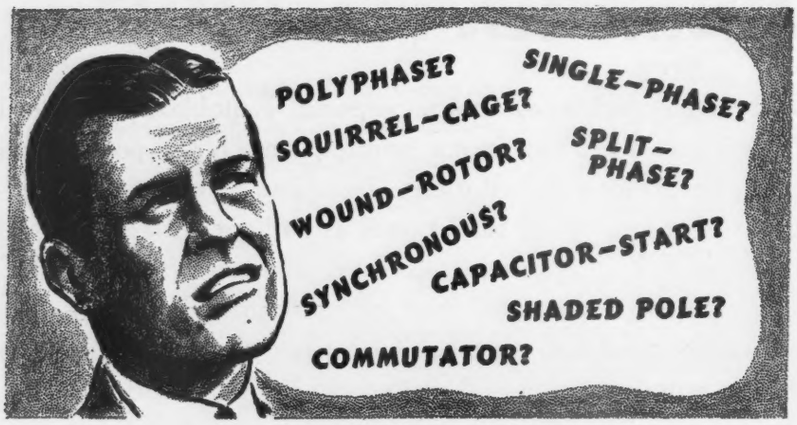
for Industry

FRANK ADAM ELECTRIC CO.

ST. LOUIS, MO. U.S.A.

WHY BE "IN A FOG"

ABOUT A-C MOTOR SELECTION?



LET GraybaR AID YOU IN FITTING MOTORS TO THE JOB

When you put your motor and motor-control problems up to GRAYBAR, you get a double assurance of sure performance: (1) GRAYBAR offers the complete line of *General Electric* motors and controls — backed by G-E research and manufacturing facilities — the line which GRAYBAR experience has proved of greatest value to its customers; (2) GRAYBAR representatives and specialists "on call" are prepared to assist you in choosing the right equipment for the job — service to you is their primary responsibility.

Whether you're selecting motors for plant motive power or types to be "built on" to equipment for resale — it will pay you to put your problem up to GRAYBAR.

GRAYBAR ELECTRIC CO.
Graybar Building,
New York, N. Y.

SPLIT-PHASE MOTORS for Fractional HP Service

For small power tools, pumps, fans, business machines and domestic devices, G-E split-phase motors offer many special advantages in the 1/60 to 1/3 h.p. range. Write GRAYBAR for new bulletin "Split-Phase Motors —Type KH" for full details.

FREE BOOKLET AIDS SELECTION

This free booklet, "How to Select A-C Motors and Control," contains nine factual articles on the special characteristics of different type motors, service factors, capacity ranges, etc. Write GRAYBAR for your copy.

GraybaR IN OVER 80 CITIES

GraybaR QUALITY SINCE 1869 *Everything Electrical* GraybaR ELECTRIC COMPANY

on the demands of the thermostat; continuous automatic fan operation only when steam is being supplied to unit heater; a manual off-on automatic switch in order that the fan may be run constantly or, if no heat is required, shut off entirely. An optional feature provides means of automatically shutting off the fan when there is no steam pressure in the main steam line. The system may be either pneumatic or electric. Minneapolis-Honeywell Regulator Co., 2945 Fourth Avenue, S., Minneapolis.

Circuit Breaker

Type M Multi-breakeR for use on 3-phase, 4-wire, solid-neutral, 120 and 208-volt a.c. systems features common trip.

When an overload or short circuit occurs on any one pole (3-pole breakers with neutrals are used), all poles trip simultaneously. Trip-free, the breakers can't be held closed on a short circuit or overload. Handle indicates "on," "off," or "tripped." Units are calibrated and sealed at the factory. Capacities range from 15-100 amperes. Sheet-steel enclosures are furnished for flush or surface mounting. Square D Co., Detroit.

Hanger Bearing for Screw Conveyors

Features permanent seal, lubrication for life, self-alignment, rust resistance, Meehanite housing, airtight seals to keep out dirt. For mounting bearing on shaft, one-half dog point setscrews with lock wires are furnished as standard equipment. Available for seven shaft sizes ranging from $1\frac{7}{16}$ to $2\frac{15}{16}$ in. in diameter. Stephens-Adamson Mfg. Co., Aurora, Ill.

Diesel-Electric Locomotive

Forty-four-ton locomotive, 380-hp. rating, is for general operation in small yards, switching in large yards, light traffic and branch-line service. Features 4 light-weight high-capacity motors, one for each axle. Each of the 2 heavy-duty 4-cycle diesel engines delivers 190 hp. at 1,000 r.p.m. Each of the 2 differential split-pole controlled generators supplies power to 2 motors permanently connected in parallel. Dead-man control and visibility are among

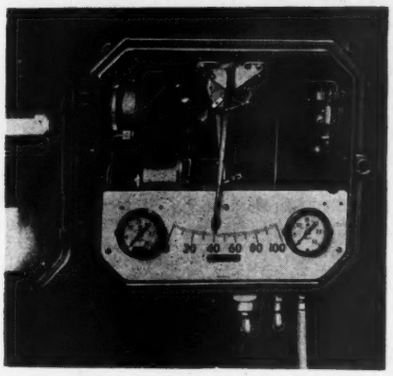
the safety features. Battery charging is provided at all speeds including idling. Multiple-unit control is featured for dual operation where required. Said to be able to haul 224 tons on the level at a maximum speed of 35 m.p.h., or 67 tons on a one percent grade; or 357 tons at 5 m.p.h. on a 2 percent grade. General Electric Co., Schenectady, N. Y.

Detachable Reflector

Utility Flu-O-Flector is a fluorescent lighting fixture with detachable aluminum reflector. By unscrewing two large knurled nuts maintenance crews can take down dirty reflectors and clean them on the floor or at the bench. High power factor lamp control and accessible starter switches are secured in the housing which is fabricated of heavy-gage galvanized steel. The Edwin F. Guth Co., 2615 Washington Ave., St. Louis.

Remote Pneumatic Transmission System

Provides a means of indicating, recording, or controlling process variables remote from the point of measurement and is particularly useful where it is desirable to correlate temperature, pressure, flow, or liquid-level data on a centralized panel or

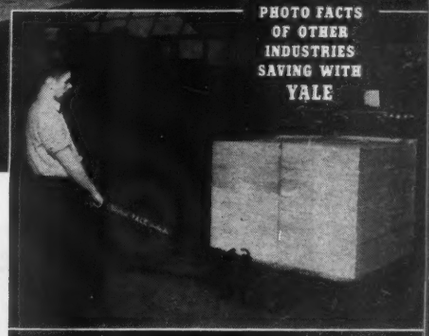


in a control room. May consist of one or two transmitters connected to a receiver, one or more receiving instruments as far as 1,000 ft. from the transmitter. Air pressure is the transmitting medium with ¼-in. outside diameter copper tubing as means of connection. Said to do away with electrical circuits in explosive atmospheres, thus eliminating hazards of electrical transmission, and to measure, transmit, and receive regardless of electrical current failures. Taylor Instrument Companies, Rochester, N. Y.

Boiler Heating System

Automatic system for steam drainage and boiler feeding. Deaerates water fed to boilers. Adaptable to any conditions in plants operating up to 250 lb. pressure, and functions without pumps or other mechanisms. Condensate and make-up water can be handled at temperatures of 212 deg. and higher. Free oxygen and non-condensable gases are liberated from all water fed to boilers through the system. Centrally located bearings carry weight of tank and connections without

PHOTO FACTS OF OTHER INDUSTRIES SAVING WITH YALE



PAPER

METAL WORKING

SMALL PARTS

YALE HAND TRUCK *reduced* CAR UNLOADING COSTS OVER 93% . . . . .

At a large metal plant* in Chicago, average car unloading time ran 67 hours at a total cost of $33 per car.

With the adoption of a Yale Tin Plate Hand Lift Truck and pallet system, car unloading time was reduced to a maximum of 4 hours at a cost of only $2—a saving of $31 per car, more than 93%.

Are your car unloading costs too high? Have your local Yale representative check them with you. He can show you how Yale Hand Lift Trucks can make a similar saving for you. Get in touch with him or write to us.

*Name on request.

THE YALE & TOWNE MFG. CO.

PHILADELPHIA DIVISION, PHILADELPHIA, PA., U. S. A.
IN CANADA: ST. CATHARINES, ONT.

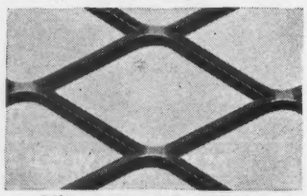
Makers of Yale Hand Chain Hoists, Electric Hoists, Electric Industrial Trucks, Hand Lift Trucks and Skid Platforms.

This Free Sample Kit of MILCOR Expanded Metal suggests many money-saving uses to you!

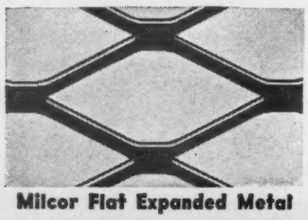
Helps you do a better job on applications where you may now use other materials

Send for it today!

Free Milcor Expanded Metal Kit suggest new ways to save money and do a better job, by using Milcor Expanded Metal for (1) *improving the salability and appearance of your finished product* . . . (2) *protecting your workmen* (by using it as a machine guard material) . . . (3) *preventing property loss* (by using it as a guard and partition material). Variety of other uses.



Milcor Expanded Metal



Milcor Flat Expanded Metal

Kit contains samples of all six standard sizes, and tables of weights, etc. Helps you see how Milcor Expanded Metal gives adequate protection, yet permits light, ventilation, vision. Helps you see for yourself that it can be cut in any direction to form the desired shape economically . . . that strands cannot ravel or loosen.

Write today on your business letterhead and ask to have your free Milcor Expanded Metal Kit sent to you. F-138

MILCOR STEEL COMPANY

MILWAUKEE, WISCONSIN CANTON, OHIO

CHICAGO, ILL. • KANSAS CITY, MO. • LA CROSSE, WIS. • ATLANTA, GA. • NEW YORK, N. Y. • ROCHESTER, N. Y. • BALTIMORE, MD.

Sales Offices: Minneapolis, Minn., Little Rock, Ark., Dallas, Tex., Denver, Colo., Washington, D. C.

possibility of straining the trunnion and packing boxes. The trunnion, and the steam and water end, are extra heavy, made of naval bronze. W. M. Acker Organization, Inc., 3167 Fulton Road, Cleveland.

Electric Circuit Breaker

Six-oz. midget switch combines a cooperative magnetic and thermal trip. Said to be able to interrupt short circuit currents up to 5,000 amperes. It permits passage of momentary current inrushes which

normally occur when motor-driven appliances are started, yet also operates within 1/60 sec. to open the circuit when the overload becomes dangerous. The thermal action is designed to take care of inrush currents, the magnetic action gives practically instantaneous circuit opening for short circuits down to 200 amperes. Available in ratings of 15-35 amp., single pole only, 250 volts a.c. and 125 volts d.c. Westinghouse Electric & Mfg. Co., Dept. 7-N-20, East Pittsburgh.

Chronograph

Double-button Multichron wrist watch, Style 230-7B, features 4 dials on one face: Fifth-seconds dial for timer purposes, hour and minute watch dials, Tachometer gage to record m.p.h. speed, Telemeter dial to indicate distance of light and sound. The dial has a black face for legibility. May be had with white face. Equipped with a 45-min. register. Two button feature—pressure on one button will consecutively start, stop, and again start sweep-second hand, pressure on other brings sweephand back to zero. Movement parts are rust-resistant and non-magnetic, it is said. Nivarox hairsprings and Glacidur metal balances used to reduce contraction and expansion due to variation in temperature. Useful in time study work, aviation, research. Jules Racine & Co., 20 West 47th St., New York.

Paint Stick

Markal A solidified paint in stick form marks both hot and cold surfaces where wide variation in temperature is encountered; e.g., at plate mills, Stickers at the open hearth. Especially adapted for marking cold metal parts that require annealing treatment at temperatures 1,400-1,600 deg. F. Once applied, the marks are said to be capable of withstanding a tempera-

By actual comparison...

THE SENSATIONAL NEW ALLIS-CHALMERS VARI-PITCH SPEED CHANGER

COSTS LESS TO RUN TAKES LESS SPACE IS MORE EFFICIENT

Make Your Own Comparisons ... and Be Convinced!

Compare Costs Coupled to a standard, low cost, high speed motor, the new Allis-Chalmers Vari-Pitch Speed Changer starts cutting costs right there. No need for expensive multi-speed motors or separate change-overs! And operating costs are cut. There are no springs to get out of order . . . no time-wasting steps . . . no trial-and-error guesswork! No wonder the Vari-Pitch Speed Changer costs less to run!

Compare Size Actually, the Vari-Pitch Speed Changer occupies only ¼ to ⅓ the space required by other, bulkier variable transmissions on the market today. Double shaft extensions allow the unit to be driven from either side or either end . . . by Texrope drive or by direct connection to the motor! Put the Vari-Pitch Speed Changer wherever you want it . . . there's no need for a complicated layout!

Compare Efficiency Allis-Chalmers makes no claims for efficiency for the new Vari-Pitch Speed Changer. Instead, we offer you this *fact*. The Vari-Pitch Speed Changer has attained efficiencies as high as 95% . . . efficiencies *proved* in a series of actual tests under load!

Get the whole story. Get *all* the facts. Send for Bulletin B 6013. Find out how you can cut costs . . . save space . . . increase production with the new Allis-Chalmers Vari-Pitch Speed Changer. Make your own comparisons . . . *and be convinced!*

Available in sizes from 1 to 75 hp, ratios up to 3¾ to 1, maximum output speed 3500 rpm, the Vari-Pitch Speed Changer is a product of Allis-Chalmers, originators of the Texrope Drive and the Vari-Pitch Sheave.

Texrope V-Belts • Duro-Brace Texsteel Sheaves • Texdrive Sheaves • Stock and Standard Cast Iron Sheaves • Vari-Pitch Speed Changers • Vari-Pitch Sheaves • Adjustable Pitch Diameter Cast Iron Sheaves • 2-3-4 Cast Iron Combination Sheaves • Paraline Automatic Motor Bases • Oil Field Drive Equipment and Drilling Rigs.

Belts by Goodrich

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

HUSKY HELPER CUTS HANDLING COSTS... ADDS STORAGE SPACE

• MOBILIFT is the compact lift truck that is making sensational savings in handling goods weighing one ton or less per unit. Reasons for MOBILIFT'S profit-making ability: (1) *low cost,* prices begin a little over $1000; (2) *light weight,* around 2600 lbs.; (3) *compactness,* works in narrow aisles and inside cars and trucks: (4) *brawny power,* forks lift loads to 9 ft.; (5) *thrifty operation,* about 15c per hour.

Let a MOBILIFT engineer analyze your materials handling problems, prove how you can cut costs and lighten labor fatigue.

Write today for literature and name of nearest dealer.

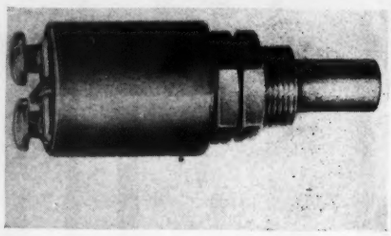
Vaughan Motor Co., 861 S.E. Main, Portland, Oregon.

MIGHTY MIDGET MOBILIFT

ture of 1,600 deg. F. The metal part can be immersed in oil or water after annealing without impairing the mark. Two types for hot surfaces: White, green, yellow, red, blue, black for temperatures from 180-1,500 deg. F.; in white for temperatures from 300-1,800 deg. F. Said not to run, char, flow, or discolor; to adhere to the metal after it has cooled; to withstand weather conditions. Material for marking cold surfaces such as steel, lumber, building stone, structural steel, galvanizing iron, glass, slate, plastics can be employed to mark on wet or dry surfaces. Dries like liquid paint. Markal Co., 6 East Lake St., Chicago.

Limit Switch

The Clicker, originally designed for aircraft use, can now be used to limit the movement of electrically operated machines. Of the double-break type, it has two ¼-in.



silver contact buttons, make and break, on 2 strips of silver. Casing and plunger are aluminum. Long mounting nose permits adjustment for travel and over-travel. Takes a ⅔-hp. motor; weighs ⅝ oz.; is rated at 110 volts, 6 amp., inductive load, a.c.; has 7/32-in. travel and same over-travel. Robert Hetherington, Sharon Hill, Pa.

Boiler Feed Pump

No. 30SH boiler feed pump makes "pressure equalizing" available to small steam plants. It admits boiler pressure into the pump receiver much like a return trap. With pressure on both sides of the pump equalized, the pump has only to raise the condensate a few feet to the boiler water level. The pressure on the suction is said to allow the pump to handle condensate as hot as 300 deg. F. without danger of vapor binding, and as returns can be passed on to the boiler before much heat has been lost an increase in thermal efficiency is claimed. Consists essentially of a cylindrical receiving chamber and a vertical close-coupled centrifugal pump mounted on a cast-iron base. The pump occupies approximately 30x14 in. floor space, weighs 168 lb., is rated at 10 gal. per min., requires a ½-hp. motor, is suitable for boilers up to 30 horsepower. Johnson Corp., Three Rivers, Mich.

Cutting Tools

Line of cemented-carbide tipped standard cutting tools covers 5 standard styles and three grades. The tools are capable of conversion into a wide variety of tool forms and single-point tools. To differen-

PRODUCTION BLOCKED BY A SLUG OF WATER

A Case Story

SOLVED WITH PREVENTIVE MAINTENANCE

TOMORROW—hundreds of plants may face a case like this: A midwestern manufacturer was suddenly swamped with orders. The plant had a good reserve capacity—yet, push as the management did, it failed to get the output needed.

The boilers and machinery were in excellent shape—but the steam lines were sluggish. The ailment was a common one—a condition that's quickly corrected with proper equipment.

That's how Preventive Maintenance entered the case. For, it's the only sure way of solving piping problems and keeping them solved. This simple technique guides you in installing and caring for pipe lines correctly; it helps you choose the right valves and fittings for every service.

This case shows how Preventive Maintenance works. While the management raved, the Superintendent put his hands on the trouble. The machines were not only slow in heating up, but they wouldn't stay hot. The drainage system was inefficient—it failed to remove condensate rapidly enough to keep the machines at maximum temperature.

The backlog of orders haunted the Superintendent. He saw that more than ordinary maintenance was necessary. "The Crane man," he said as he reached for a phone, "will help us solve this quickly and surely."

The two men reviewed the situation. To run the machines at top speed meant keeping them at maximum temperature. Condensate would have to be drained as rapidly as it formed. The correct solution, as Preventive Maintenance counseled, involved redesigning of the drainage system, and installing a Crane Inverted Float Trap on each machine.

Results: The condensate trouble was banished. Production was immediately doubled. Another user of piping knows the value of Preventive Maintenance. Also, knows that the best way to get most from piping maintenance dollars is to call in the Crane Man. Because, backed by Crane experience and the great Crane line of valves and fittings, he offers the means of a successful Preventive Maintenance program.

This case comes from the personal experience of W.F.C. —a Crane Representative in the Kansas City Branch

YOUR STEAM LINES KEPT HOT AND DRY WITH CRANE TRAPS

You are not getting the maximum heat and power from steam if your lines are not properly drained. You are straining the piping, shortening the life of valves, exposing steam-operated equipment to serious damage when condensate is not removed.

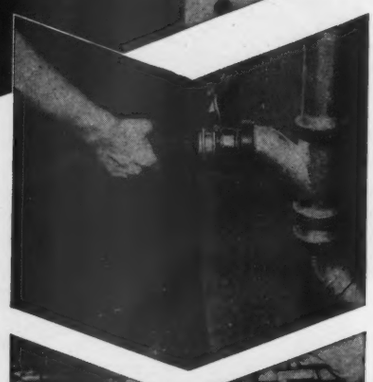
In steam lines up to 600 pounds pressure, the wasteful and damaging effects of condensate are completely eliminated with Crane Inverted Open Float Steam Traps. These sturdy, simple, and low-cost traps will pay for themselves many times over. Once installed they require minimum attention —yet, automatically, stop steam waste, step up efficiency.

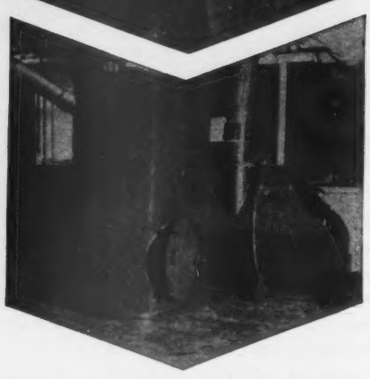
For pressures up to 200 pounds, the Crane line of No. 981 traps will give maximum protection against condensate troubles.

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS





IF YOUR PRODUCT IS *"Built like a Watch"*

you will be interested to know that watch, radio, ceramic and similar industries use Spencer Vacuum Cleaning not only because it reduces cleaning costs, but because it saves on production costs and rejects due to dust as well.

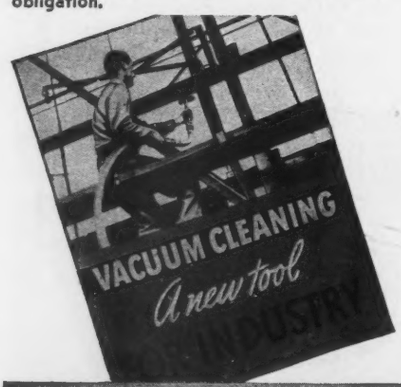
A watch manufacturer says: "Our factory installed two Spencer vacuum cleaning units for cleaning the floors in 1914. These units performed so satisfactorily that a third Spencer installation was specified for our new building fourteen years later.

"Today all three units are doing their daily job. The Elgin National Watch Company is pleased with their Spencer Turbines."

Another large watch manufacturer in the east cleans 180,000 square feet a day with a Spencer and estimates that the original cost will be written off at the end of three years.

Spencer Vacuum Cleaning is fast, effective and economical. It reduces health, fire and explosion hazards, cleans floors, machinery and overhead, and handles all kinds of materials from lint to lead, and sand to sawdust.

If you have bulky or heavy litter in your plant, a trial of the new Spencer 7½ HP (7½ cu. ft. dirt capacity) Portable will convince you without obligation.



The three essentials for heavy duty vacuum cleaning.

Top: Light weight handles with swivel joint and suitable vacuum tools.

Center: Durable vacuum hose and 2" piping sytem with inlets on each floor leading to—

Bottom: A powerful vacuum producer with separator and dirt receptacle of ample capacity in the basement.

THE BOOK OF EXPERIENCE: What vacuum cleaning is doing in industry as reported by a survey of 444 users of Spencer Vacuum Cleaning Systems ranging from ¾ HP portables to 100 HP stationary systems.

ASK FOR BULLETIN No. 120-P.

182-E

SPENCER HARTFORD

CENTRAL AND PORTABLE VACUUM CLEANING SYSTEMS

THE SPENCER TURBINE COMPANY, HARTFORD, CONN.

tiate the tools for steel cutting and for machining of cast iron, the shanks of the former are copper colored, those of the latter are finished in aluminum. Tools made of Grade 78B, general-purpose grade for steel cutting, are designed to take cuts up to ¼ in. deep and feeds up to 0.03 inch. For machining cast iron, the standard tools are available in two optional grades. Carboloy Co., Inc., Detroit.

Swing Joint for Steam Lines

Flexible joint for handling steam pressures up to 100 pounds. The sealing unit is a specially shaped and compounded rubber gasket which contains finely divided metallic lead milled directly into the rubber. Because the lead acts as a lubricant the joint turns freely under pressure. The gasket expanded slightly by the heat helps to maintain a perfect seal. The joint is made of heavy bronze, weighs approximately 4½ lb., is available in the ¾-in. straight style. Patterson-Ballagh Corp., 1900 East 65th St., Los Angeles.

Furnace Pressure Controller

Controller combines with a motor-driven interrupter, a relay, signal lights, a motor-drive unit to form a complete L&N system designed to control pressures of metallurgical and other industrial furnaces. Mechanism is housed in a die-cast case, is designed primarily for flush mounting, can be supplied for surface mounting. Selector switch and pushbutton station are built into the controller door enabling the operator to take over on manual control when necessary. Control setting knob, dial calibrated from —0.05 to 0.05 in. water, and a stationary pointer are also located on door. (Pressures up to ± 5 in. of water can be accommodated.) One set of weights adjusts zero setting of instrument's mechanical balance, second set adjusts sensitivity. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia.

Drill

Model 80 ½-in. drill is said to have 100 percent anti-friction bearing construction and a 2-pole safety switch with 100 percent overload capacity. It weighs 8 lb., is 11½ in. long and 9¾ in. high, and is suited for use in tight places. Built with a universal motor, it has no-load speed of 450 r.p.m., full-load speed of 300 r.p.m. Drilling capacity in steel is ½ in., in hardwood 1¼ inches. Skilsaw, Inc., 5043 Elston Ave., Chicago.

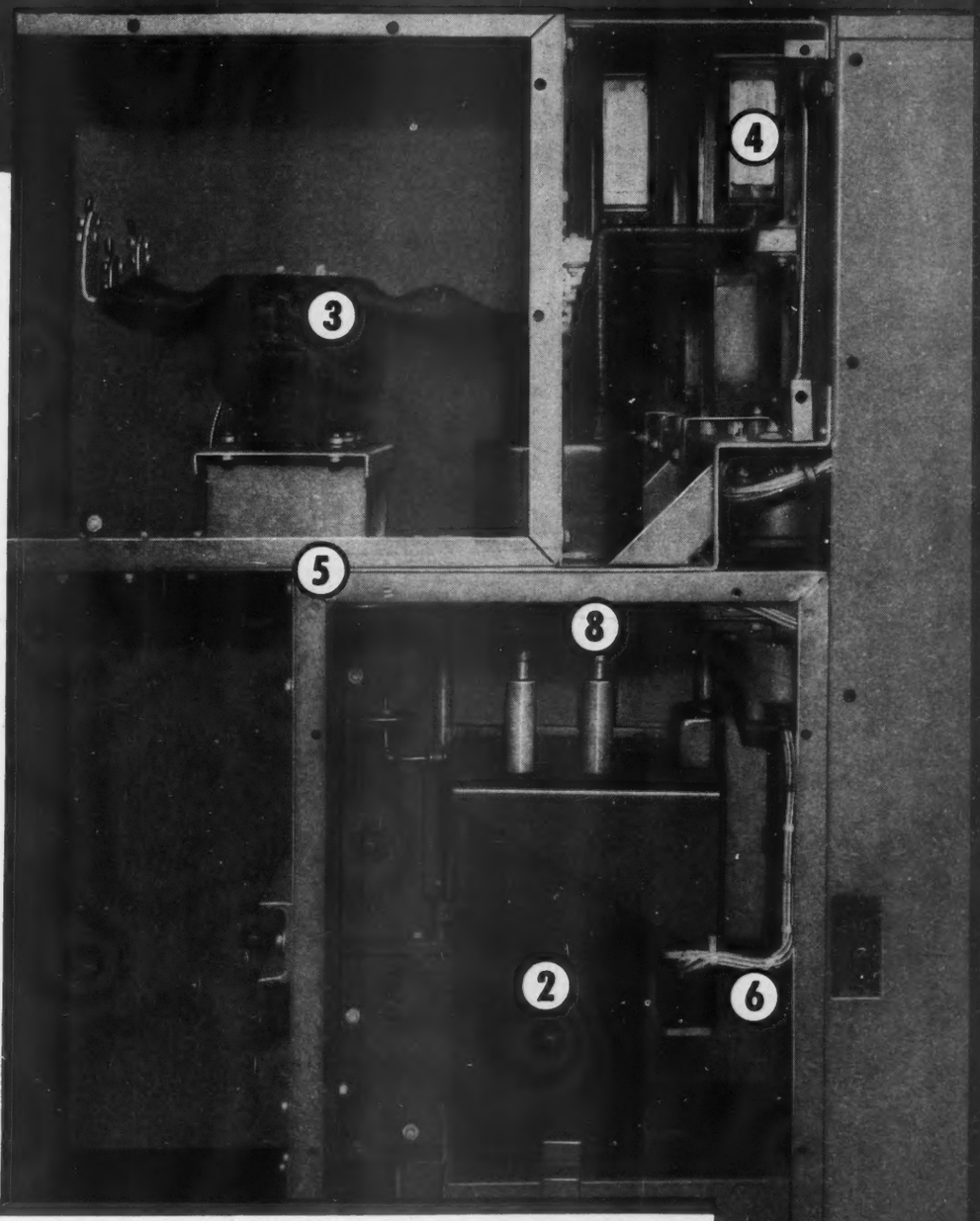
Electric Counter

Mercury counter is said to have energy requirement of about 2 watts rated voltage which suits instrument for electric-eye operation. Five number wheels record to 99,999 and repeat. Figures are white on black wheels. Case and frame are cadmium-finished steel with unbreakable plastic windows. The counters are available for any 60-cycle a.c. voltage up to 230, and for d.c. up to 115 volts. Production Instrument Co., 700-06 West Jackson Blvd., Chicago.

SWITCHGEAR EQUIPMENTS

MODERN G-E METAL-CLAD

1. **SAFETY** — All live parts are enclosed
2. **EASY AND QUICK MAINTENANCE** — Because the breakers are easily removable
3. **CO-ORDINATION** — Current transformers have sufficient mechanical and thermal capacity to match circuit breaker
4. **INSULATED BUSES** — Herkolite insulation—rigid supports
5. **COMPLETE ISOLATION** — All parts of the circuit are isolated in individual steel compartments
6. **CONTROL WIRING SHIELDED** — Wiring is covered with steel protective armor
7. **MECHANICAL INTERLOCKS** — Direct acting so that the disconnecting devices cannot make or break load current
8. **DISCONNECTING DEVICES**—Lowering the breaker automatically opens the disconnects
9. **INSTALLATION**—Factory-assembled equipment is easily installed at a low, predictable cost



Ask for Our New Descriptive Bulletin

After you have compared modern G-E metal-clad with the old open-type equipment, we are sure you will want to know more about it. A switchgear specialist in the G-E office nearest you will be glad to give you the facts about this completely factory-built, shipped-assembled equipment. Ask him for a copy of our new descriptive bulletin, GEA-2249C. General Electric, Schenectady, N. Y.

▲ Side view of Type MI-9 metal-clad equipment with breaker completely disconnected and lowered on transfer truck. Side plate removed to show internal arrangement. Note method of enclosing all live parts.

GENERAL ELECTRIC

For Us, Infra-Red Drying

(Continued from page 59)

lost when the switches are turned off.

Safety is enhanced. Sprinkler heads above the tunnel are not affected because there is no hot air circulated to rise and cause trouble. In fact, we did not have to change the heads over the oven; they are the same as those used throughout the plant.

Frequently, in painting a product, a scratch or other defect involves a patching job; this must be dried or baked. Air-drying takes space, but a bank of infra-red lights can be used to speed up the process. This happened on our space heater line, but in this case it was an added operation in the form of a stripe. Production at first did not warrant an oven to dry it, but an increase in output required more factory space for drying than was available. A portable unit of infra-red lights solved the difficulty quickly, and at very little cost. In fact, since the tunnel lights are in units of six lights attached to a wire channel box containing the sockets and wiring, they are very easy to handle about the shop.

Maintenance cost, always a question mark with any new process, is practically nil. In three months of running the tunnel eight hours per day, only 5 bulbs in the 360 had to be replaced. Cleaning is not much of a problem. Since there are no fans and currents of hot air, the paint fumes settle, which means that the bottom rows of the reflectors have to be cleaned, but this is necessary only every 30 days, and, as mentioned before, a caustic soda dip does the trick. Since no controls are used, only 100-amp., 3-pole switches, a large item of maintenance is eliminated altogether.

Cost reduction and flexibility are, however, the main things that I should like to stress. There is nothing in this set-up that would prevent its being used on other products. Indeed, we have found that the reduced investment and lowered operating costs have allowed us to bid on jobs not hitherto possible.

Buy Steel with LABORATORY CERTAINTY -at Ryerson

Every shipment of alloy steel is accompanied by accurate data based on laboratory tests, covering exact chemical and physical properties, grain size, cleanliness rating and hardening characteristics. With the Ryerson data sheet before you, you know what steel you are getting, you secure best heat treatment results and you save time because you do not have to test.

Ryerson stocks also include a wide range of stainless, heat- and corrosion-resisting steels, sheets and tubing—all closely controlled as to chemical content. Many highly specialized steel requirements can be supplied on a moment's notice!

Ryerson Steel-Service is geared particularly to the needs of defense industries. All Ryerson products are painstakingly selected for their uniform high quality. They are carefully warehoused, accurately cut to your specifications, and shipped on the dot from ten convenient stocks of over 10,000 sizes, kinds and shapes.

Submit your next steel problem to the nearest Ryerson plant. If you haven't the 1940-41 Ryerson stock list and data book, send for it today. It will quickly become your guide to quality steel and fast steel service.

Joseph T. Ryerson & Son, Inc., Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON CERTIFIED STEELS

RYERSON

Upped Output 2½ Times in 10 Months

(Continued from page 51)

of the loading dock conveyor system. This hoist carries a section of the conveyor and may be lowered to low-bed or standard truck height; the dock is at car-floor level. Cases for truck shipment are placed on the conveyor inside the building by crane, rolled out to the hoist, then lowered to proper truck level. The turntable arrangement makes it possible to revolve the hoist-table conveyor section to line up with the truck bed; a hinged apron section of conveyor is dropped to extend a few feet into the truck. Hydraulic pump and controls are conveniently located in a small shed at the outdoor end of the dock; this shed also houses an electric winch used for spotting cars and pulling exceptionally heavy loads along the conveyor.

Careful Planning Paid

The extended plant construction, started last December 20, is now virtually complete. All departments are now operating. All phases of the materials handling system have been in use for some months and are completely satisfactory. Despite the confusion of reorganizing the department layout, the careful advance planning and judicious selection of new equipment was amply rewarded. Operations were smoothly accelerated, and former "bottlenecks" disappeared.

Wagner Act Quiz

(Continued from page 63)

conditions request the NLRB to hold an election and establish thereby the appropriate bargaining union. T F

28. A foreman should indicate by word or action that he, or the company for which he works, either approves or disapproves of any labor organization to which workers belong or want to belong. T F

29. It is illegal for a foreman or a supervisor to fire, demote, or otherwise punish a worker merely because of his labor affiliation. T F

30. The act prohibits an employer from aiding one employee organization while opposing another. T F

31. The foreman need not "watch his step" in taking remedial action if a union man's work is not up to par, if he is "laying down" on the job, or if he is persistently insubordinate. T F

32. Labor organizations confined to one plant, and not dominated or interfered with by the employer, are considered legal under the act. T F

33. If a worker asks about the prospects of remaining on the job, or being reinstated, provided that he is temporarily out of work, the foreman may express an opinion of his chances so long as no mention is made of the worker's union membership or lack of it. T F

34. Congress has established a policy whereby the federal government encourages the practice and procedure of collective bargaining. T F

35. It is legal to hire strikebreakers to break up a union. T F

36. The personnel man is expected to give advice about joining a union. T F

37. You should use force against labor organizers whether or not they themselves are employees. T F

38. If a union, representing the majority of your workers demands a wage increase, and you and your superiors feel that the company finances could not stand any additional expense, then the management is not violating the law if after a complete discussion and explanation, it turns down the union's proposals. T F

39. The foreman may legally try to protect his non-union workers from persuasion by the union workers. T F

40. An employee who has filed charges or given testimony may be discharged for such action. T F

41. An employer may refuse to bargain if the strikers are using violence or other unlawful methods. T F

42. Collective bargaining agreements should always be in writing providing both union and employers agree on terms. T F

43. A closed shop limits the employer's independence of action and strengthens the union. T F

44. Malicious remarks about unions uttered by persons having authority to hire and fire, or to recommend hiring or firing, are not considered an unfair labor practice (and therefore illegal). T F

45. The employer cannot legally direct influence over third parties, such as the local police or citizens, in trying to persuade workers against forming a union. T F

46. The employer has a legal right to ask employees to return to work when such a request is intended to break the ranks of workers legitimately on strike. T F

47. The use of propaganda to influence workers against any organization of

Raising and lowering is done at speed of 32' per second.

THE trick here is to snatch red hot metal parts out of a furnace and "dunk" them into a tank of oil quickly before they catch a chill. It's a simple, efficient system devised to protect the temper of metals through fast handling.

It's one of hundreds of applications where P&H Hoists are used effectively to save time and money and speed up manufacturing processes.

A P&H engineer can show you, without obligation, how P&H Hevi-Lift Hoists can help you solve your handling problems. *Write for Bulletin H-5.*

P&H HEVI-LIFT HOISTS

HANDLE IT "THRU-THE-AIR"

General Offices: 4525 West National Avenue, Milwaukee, Wisconsin

HARNISCHFEGER CORPORATION

HOISTS • WELDING ELECTRODES • MOTORS P&H EXCAVATORS • ELECTRIC CRANES • ARC WELDERS

their own choosing is considered illegal. T F

48. A good rule-of-thumb test of the independence of a labor organization is whether it affords its members a free voice in presenting demands to management. T F

49. The employer retains his right to discharge an employee for poor work, carelessness, drinking on duty, and any similar reason other than union affiliation or union activity. T F

50. The NLRA does not prevent workers, if they choose, from retaining their membership in a plant union provided it is not a company-dominated organization. T F

51. The NLRB has the power, subject to court review, to say whether or not the employer has bargained in good faith. T F

52. Collective bargaining refers to negotiations between employers and employees' representatives which are intended to result in an agreement respecting wages, hours, and other working conditions applicable to a class of workers or to a group thereof. T F

53. Even though a majority of workers in an appropriate bargaining unit request collective bargaining, the employer may legally refuse to meet with them for that purpose. T F

54. An employer may set up an appropriate bargaining unit. T F

55. An employer must express willingness to enter into collective bargaining soon after a majority of the employees in the appropriate bargaining unit, either themselves or through designated representatives, demand it. T F

56. The employer is not required to agree to any demands of a labor organization so long as his "good faith" in bargaining is established. T F

57. The NLRA does *not* require workers *to* join an outside union unless *a* closed-shop contract is involved. T F

58. An employer may refuse to bargain collectively on the grounds that the demands are exorbitant or impossible to meet. T F

59. In any closed-shop agreement, the employer must undertake to unionize all present and future workers. T F

60. The employer may hire, retain, or discharge union or non-union men for any reason other than union affiliation or union activity in a shop in which no closed-shop agreement has been signed. T F

61. An open-shop employer may refuse employment to a person because he is affiliated with a union. T F

62. The employer may, in some closed-shop agreements, hire any worker he desires, regardless of union membership, and retain him for a prescribed trial period of one to several weeks, and then at the end of such period he must either dispense with his services or see to it that the worker is enrolled in the union. T F

63. When a demand for a closed shop is made by the union, such demand cannot be made the basis of a refusal to bargain. T F

64. The United States Supreme Court has defined "good faith," as required of both employer and employee representatives in collective bargaining, as an "honest effort to reach a bargain." T F

65. If it becomes necessary to engage additional help in some departments, while there is insufficient help in other departments, the regular workers who can fill these jobs are usually entitled to preference. T F

66. Minority groups of workers in an appropriate bargaining unit are not deprived of an opportunity to bargain through representatives of their own choosing even though some labor organization is found by the NLRB to repre-

GREATEST "BUY" IN DRILL HISTORY!
SKILSAW
½ in. SPECIAL DUTY DRILL
100% ANTI-FRICTION BEARING CONSTRUCTION FOR ONLY . . .
$44
Weighs Only 8 LBS!
ONLY 3½" WIDE

LOOK at these features and you will decide to BUY! Compact, modern die-cast body, helical-cut gears for smooth performance. 2-pole safety switch. Every moving shaft mounted on a friction-free ball or needle-roller bearing. Powerful Universal motor for fast drilling.

The new SKILSAW Model 80 DRILL *belongs* in your plant . . . *it is the biggest drill value* on the market today! Ask for a demonstration.

SKILSAW, INC.
5043 ELSTON AVENUE, CHICAGO

36 E. 22nd St., New York; 182 Main St., Buffalo; 52 Brookline Ave., Boston; 15 S. 21st St., Philadelphia; 2902 Euclid Ave., Cleveland; 2124 Main St., Dallas; 918 Union St., New Orleans; 2645 Santa Fe Ave., Los Angeles; 2065 Webster St., Oakland; 29 North Ave., N. W., Atlanta; Canadian Branch: 85 Deloraine Ave., Toronto.

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PORTABLE ELECTRIC TOOLS

SEE YOUR DISTRIBUTOR ...he will gladly demonstrate how SKILSAW TOOLS will save you money

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When speed, accuracy and finish are vital to your profit, use Disston Bite-Rite Files! Teeth, staggered like a harrow, cut, smooth, and level at each stroke. The Bite-Rite correct shape of cutting tip, rugged shoulders between the teeth . . . the round, smooth, open gullet which assures free, clean discharge of chips (heavy, long, curling chips like those from a lathe tool) . . . these features give you the Disston Bite-Rite File advantages—*Speed of cut, long life, smoothness of filed surface!* Change to Bite-Rite Files. You'll discover new sources of profit. See your Disston distributor, or write to Henry Disston & Sons, Inc., Philadelphia, U.S.A.

DISSTON PARALLEL MACHINE FILES . . .

Made to file on the up stroke, but can also be supplied to file on the down stroke if required. Same width and thickness throughout. Made in a variety of sizes and patterns. Any special pattern supplied to specifications. No. 00, No. 0 and No. 2 cuts are standard.

Feel the "bite" in

DISSTON BITE-RITE FILES

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DISSTON HAS THE EDGE

sent a majority of the workers in that unit. T F

67. The act does not state that workers must bargain collectively or must join labor organizations. T F

68. Persons having supervisory authority are considered as agents and spokesmen of employers. T F

69. Every supervisor has the right to ask his workers whether or not they belong to a particular union. T F

70. A sure way for a supervisor to get his company into trouble with the NLRB is to make unfavorable statements about a labor organization to plant workers. T F

71. It is permissible for an employer to circulate anti-union petitions among the workers as long as it is not done on company property and during working hours. T F

72. Threatening to "beat up" union members or organizers, even though the threat is not carried out, is considered an unfair labor practice. T F

73. It is permissible to offer wage increases or promotions to workers on the grounds that they will join one union or refrain from joining another. T F

74. A supervisor should check up on attendance at union meetings or have someone designated by him to report the results of such meetings. T F

75. It is illegal for any supervisor or foreman to do or say anything to workers that might have the result of inducing them to join a union affiliated with the CIO. or the AFL. T F

76. Company unions, workers' councils, or other labor organizations unaffiliated with any national group are made legal by the NLRA as long as they remain entirely free from management influence or support. T F

77. Supervisors and foremen may take steps to get their workers to create a new labor organization or to join one already in existence. T F

78. Any citizen, or even another employer, as well as one of a company's workers, may file a charge that the company has violated the act. T F

79. Employees are required to sign agreements made between their representatives and the management. T F

80. The "preferential union shop" usually provides for non-union workers to continue in employment but preference in hiring and retention of employees is given to union members. T F

81. If the majority of the employees are members of the union when a closed-shop agreement is signed, the minority must then join the union or give up their jobs. T F

82. The open shop gives the employer complete liberty of action to hire and fire. T F

83. Full recognition occurs when management expresses willingness that the union is the representation of the majority of employees and therefore the exclusive bargaining representative for all employees. T F

84. In some cases closed-shop terms can be used by the employer as a trading advantage during collective bargaining by withholding it in favor of other concessions. T F

85. The NLRA states that unions can demand wage increases during a contract period, even though the management is complying with the terms of the original agreement. T F

86. It is legal for an employer to show that his competitive position would be injured if he met the wage increases demanded by his employees. T F

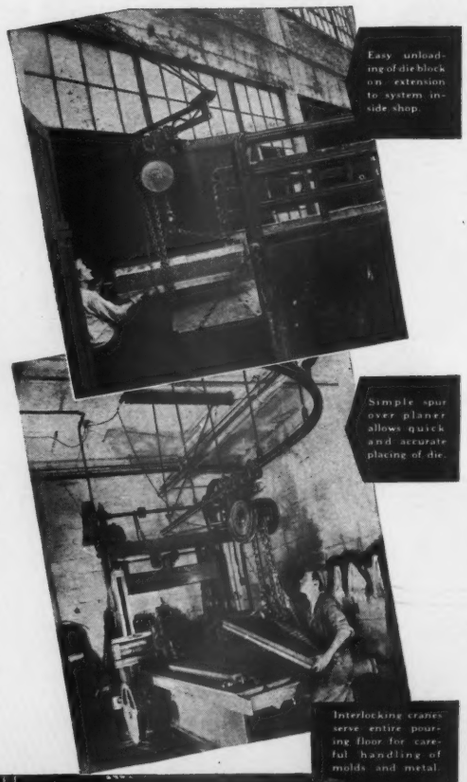
87. Wage increases may be held down by providing that they are not justified, or by holding back a closed-shop condition. T F

88. Under closed-shop arrangements, apprentices are usually required to join

Simple Methods for stepping up DEFENSE PRODUCTION

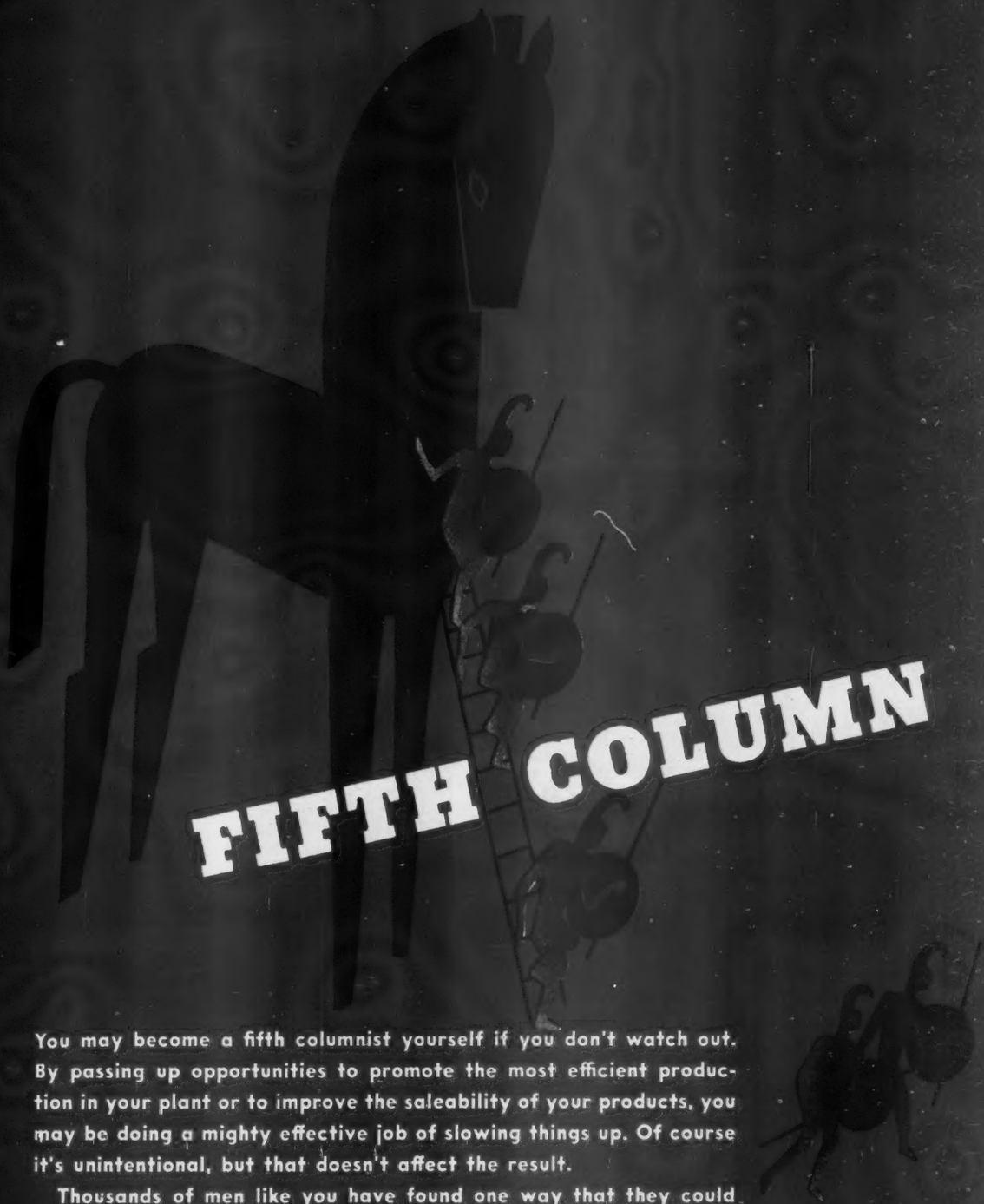
With a surging demand for greater output, plants operating on defense materiel use every possible means to obtain it. It is no wonder that these plants are rapidly installing overhead handling equipment to relieve floor congestion — to gain time through process aids — or to conserve skilled manpower by eliminating handling fatigue.

Simple systems as shown here are quickly and inexpensively applied wherever a short cut is needed. American MonoRail engineers can spot these places in a short survey of your plant. They will then offer a detailed proposal which does not obligate you in any way. Why not give them a chance to help push along your defense production?


Easy unloading of die block on extension to system inside shop.
Simple spur over planer allows quick and accurate placing of die.
Interlocking cranes serve entire pouring floor for careful handling of molds and metal.

THE AMERICAN MONORAIL COMPANY

13114 Athens Ave. Cleveland, Ohio



FIFTH COLUMN

You may become a fifth columnist yourself if you don't watch out. By passing up opportunities to promote the most efficient production in your plant or to improve the saleability of your products, you may be doing a mighty effective job of slowing things up. Of course it's unintentional, but that doesn't affect the result.

Thousands of men like you have found one way that they could make truly remarkable improvements in their plant equipment and greatly increase the saleability of their motor driven products. It's an easy way, too, they simply use Master Motors built to meet exactly the individual requirements of each job. You, too, can lower costs, improve the appearance, efficiency and safety of your product or your plant equipment. Investigate MASTER'S unusual ability to serve you promptly and economically with motors that really fit your individual needs.

THE MASTER ELECTRIC COMPANY • DAYTON, OHIO

MASTER

the union at the end of a specified trial period. T F

89. A foreman can legally act simultaneously as a supervisor and as a union recruiting agent if he belongs to a craft union. T F

90. The employer can discharge an employee for insubordination, sabotage, making insulting remarks to the employer, or failure to maintain established performance standards, even if the employee belongs to a union. T F

91. The union may rescind its agreement with an employer or resort to legal remedies if the employer violates the agreement. T F

92. Collective-bargaining agreements sometimes make provisions for such contingencies as factory reorganization, departments to be shut down, and changes in processes. T F

93. The empoyer does not, in general, bind himself to employ only members of a designated union in a closed shop. T F

94. If the employer refuses to confer with the board's representatives in the presence of the representatives of the employees, the Field Examiner will confer with each of the parties individually. T F

95. Any foreman or supervisor who wants to join a union, or is under pressure to join a union, shoud take the necessary steps in consultation with his superiors, to make sure that by so doing he is not violating the law. T F

96. An employer may violate the NLRA but may not be called to attend a preliminary hearing unless a charge or compaint has been filed against him for violation of the act. T F

97. The NLRA restricts the use of mechanical appliances which have labor or technological improvements which displace workers or speed up work. T F

98. Occasionally some of the best workers in a plant must be discharged if the union refuses to admit or expels them from membership in accordance with a closed-shop agreement. T F

99. There are lawful means available for consummating closed-shop agreements with a union of the employer's choice even though the law prohibits an employer from showing preference. T F

100. Union delegates and organizers may legally be restricted by written agreement from entering a factory. T F

Because they couldn't afford a shutdown—

THEY CHOSE EC&M STARTERS

YOU, too, may have a production problem where **continuity of service** is absolutely essential.

EC&M Motor Starters guarantee this. They also protect motors against all abnormal conditions. And they provide remote control—with control stations located at a distance from the motors.

And EC&M High Voltage Motor Starters can be safely installed out in the mill without guards or special control rooms. They are a **totally enclosed** unit.

Motor Starters bearing the trade-mark "EC&M" have won high recognition in hundreds of plants. **Low up-keep-cost performance,** year in and year out, is the reason.

EC&M Push Button Operated Low Voltage Motor Starter.

THE ELECTRIC CONTROLLER & MFG. CO. CLEVELAND, OHIO

HEAVY DUTY MOTOR CONTROL FOR CRANES, MILL DRIVES AND MACHINERY • BRAKES • LIMIT STOPS • LIFTING MAGNETS AND AUTOMATIC WELD TIMERS

THE ELECTRIC CONTROLLER & MFG. CO.
2688-F E. 79th St., Cleveland, Ohio

Gentlemen: Please send me Bulletin 1045, 1047 and Booklet 88.

Name .....

Company .....

Address .....

Every Week the Same Pay Check

(Continued from page 57)

lar work week may be decreased to 32½ hours, made up of 5 days of 6½ hours each, or 4 days of 8 hours each. Or, consecutive days off may be granted instead. In any event, the employee receives pay for 40 hours at his regular rate, the pay for the hours not worked being withdrawn from the pay reserve fund.

Balances Paid June 1

If there is a balance in the fund standing to the credit of any employee on June 1 of each year, it is paid to him at that time. And, of course, any balance standing to the credit of an employee is paid to him immediately if he leaves the employ of the company for any reason.

Office workers are not included in this wage payment plan because there is always enough work to keep them at their desks for 40 hours a week the year round.

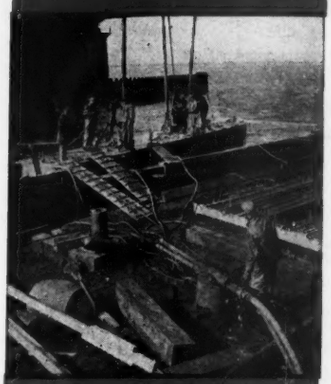
Both office and factory workers in

When Enthusiasm for . . .

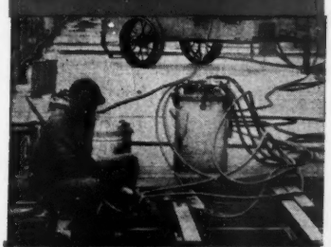
MANHATTAN HOSE

Multiplies Like this

Sand Blast Hose



Steam and Air Hose



Welding Hose

ONE user's enthusiasm for MANHATTAN Hose might not mean much, but when approval comes on a wholesale basis from many users of many different types of MANHATTAN Hose over a wide range of industries, then the cumulative evidence of service, performance and long wear can be taken as a positive indication of economy.

Cut yourself in on this service of performance economy by ordering MANHATTAN Hose—today, if you can put it to work now—81 kinds for 81 types of service.

A mill supply dealer* in nearly every important city carries stock for ordinary requirements, and he is as near as your telephone.

Condor PRODUCTS

Conveyor and Elevator Belt	Hydraulic Hose	Launder Lining
Compensated Belt	Oil and Gasoline Hose	Industrial Brake Blocks and Lining
Transmission Belt	Sand Blast Hose	Molded Rubber Goods
V-Belt	Steam Hose	Rubber Lined Tanks
Air Hose	Suction Hose	Rubber Covered Rolls
Contractors Hose	Water Hose	Abrasive Wheels
Fire Hose	Chute Lining	Bowling Balls

*Phone him

Steam, Water, Spray, Welding and Air Hose

THE MANHATTAN RUBBER MFG. DIVISION
OF RAYBESTOS-MANHATTAN, INC.

3 Townsend Street - Passaic, New Jersey

Birmingham Chicago Cleveland New Orleans New York Boston
Minneapolis Detroit Pittsburgh Philadelphia St. Louis San Francisco

certain wage or salary brackets, however, are given the benefit of our cost-of-living bonus plan.

We believe that the wages or salary of each employee should be based on the type of work he is required to do, the manner in which he performs his work, his length of service, and the importance of the work and responsibilities which have been assigned to him. Members of our organization prefer to be compensated on such a basis.

On the other hand, we believe that during periods when the cost of living is rising rapidly some recognition should be taken of the fact that without some adjustment of the salary or wages of those individuals whose income goes mostly for the purchase of necessities, hardships will result and the standard of living may have to be lowered. It is common experience that the rate of salary or wages sets the standard of living for such a family so completely that any wage reduction or any rapid increase in the cost of living will seriously threaten this standard of living and may work regrettable hardship.

Three years ago a system of special payments known as the cost-of-living bonus was established. It is paid as additional compensation and is entirely separate and apart from regular salary or wages.

This bonus is given to all factory and office employees whose earnings are at the rate of less than $100 a month. It is also paid upon the first $100 a month of the earnings of those whose salary or wages exceed $100 a month, but are less than $3,000 a year. The only requirement for eligibility is that an employee must have been with us for one entire quarter prior to the quarter in which he participates.

On the 15th of May, August, November, and February, whenever the cost of living index for Cleveland, as established by the United States Department of Labor, has increased 5 percent or any multiple thereof above the index for June 15, 1934, a cost of living bonus equal to 5 percent of the amount of the salary or wages is paid to all employees covered by the plan. Similarly, whenever there is a drop equal to 5 percent, or any multiple, in the cost of living index from the figures upon which the latest cost of living bonus has been paid, the bonus is reduced by 5 percent in the ensuing quarter, up to the point, but not below it, where the bonus may be eliminated entirely.

Chose Significant Base

June 15, 1934, was chosen as the base by which to measure any increase or decrease in the cost of living, because on that date the wage and salary cuts effective during the depression were fully restored in our organization.

The index figures for the cost of living are not published until approximately six weeks after the date upon which they are based; therefore the March 15 figures are used for May 15, the June 15 figures for August 15, and so on.

To illustrate how the plan operates, if the cost of living figures which are used as a basis show that in any quarter-year period the index has risen more than 5 percent but less than 10 percent above the cost of living index on June 15, 1934, a bonus equal to 5 percent of the wage or salary is paid in the ensuing quarter. Assume that in a subsequent quarter the cost of living index has risen to a point more than 10 percent but less than 15 percent above the index on June 15, 1934; then a bonus equal to 10 percent would be paid in the ensuing quarter. If in the next quarter the cost of living index has dropped from, say, 12 percent to 7 percent, the bonus during the ensuing quarter will be reduced to 5 percent.

It is not to be supposed that the two plans described here have been operated without cost to the company; on the contrary, they have at times cost us

For Safety and Long Wear
Inland 4-Way Floor Plate

In addition to its tread, which assures safe traction in all four directions, Inland Floor Plate has the great strength and toughness of rolled steel.

It is the ideal heavy-duty flooring for all working spaces around machinery, trucking areas, runways, platforms and stair treads.

Write for the Inland Floor Plate Catalog.

SHEETS • STRIP • TIN PLATE • BARS
PLATES • FLOOR PLATES • STRUCTURALS
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Inland Steel Co.
38 S. Dearborn Street, Chicago

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WESTINGHOUSE

ARE DESIGNED, BUILT AND TESTED AS *Complete* UNITS

Hundreds of installations in widely diversified industries have proved the outstanding advantages of Westinghouse Gearmotors for slow speed drives. Gearmotors save installation costs and reduce maintenance expense because no belts, pulleys or sprockets are required. The exact output speed can be obtained by simply installing one unit. And with a Westinghouse Gearmotor, low output speed is provided with the full efficiency of a high speed drive—efficiency ranging from 94% to 98%.

The design and construction of Westinghouse Gearmotors make it possible to solve many slow speed drive problems economically. Westinghouse Gearmotors are built as one complete unit. The result is a balanced drive in which all parts are matched to provide maximum results. Smooth, quiet operating gears are assured because Westinghouse makes its own gears—gears that are accurately cut from forged steel and heat-treated by the exclusive Westinghouse BPT process.

Built as one complete unit with all parts accurately balanced and matched, a Westinghouse Gearmotor will deliver its full torque under load and withstand the shocks of even the most severe service conditions.

Gearmotors are available in all standard motor ratings and in a wide variety of special enclosures. Your Westinghouse representative will be glad to give you complete details.

• • •

WESTINGHOUSE ELECTRIC & MFG. CO.
EAST PITTSBURGH, PA.

J-07171

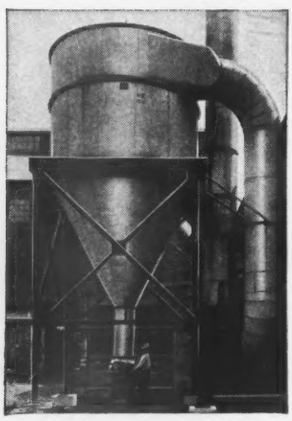
Westinghouse
GEARED DRIVES

STURTEVANT SYSTEM *ends dangerous dust condition*

How's this for a health hazard:—the flying steel particles and fine emery dust that filled the air in this swing grinder room before Sturtevant "Put Air to Work"?

But look at the picture today, above! Gone is the "dust bowl" appearance. Workers don't even need to wear dust respirators any more. And behind the scenes—responsible for this marked improvement in working conditions—is a Sturtevant Dust Removal System.

Perhaps *you* don't have as dangerous a condition as this to cope with in your plant. But this Sturtevant installation is a striking example of the way a dust and fume removal system can be engineered by Sturtevant to meet the specific needs of any plant or industry—no matter how tough the problem. Whether your problem is dust or fumes—serious health hazard or simply annoyance—it will pay you to discuss it with a Sturtevant Engineer located in our nearest office. May we put our 80 years of air engineering experience at your service?



Lighter dust generated in the swing grinder room is exhausted by this Centrifugal Cyclone Collector, after being drawn into headers shown on each grinding wheel. Heavier particles are trapped in steel box under each wheel.

B. F. STURTEVANT COMPANY
Hyde Park, Boston, Mass. *Branches in 40 Cities*
B. F. Sturtevant Company of Canada, Limited, Galt, Toronto, Montreal

Sturtevant
REG. U. S. PAT. OFF.
Puts Air to Work

AND OUT GO DUST AND FUMES!

plenty. Rather than abandon or modify them, however, we have sought to make up any losses as far as possible by increased efficiency of production and the elimination of all waste of time, labor, and materials. The resources of technical research, time and motion study, and modern equipment have been called upon freely. They have shown us how to cut costs sufficiently to support our employee welfare plans at a price we can afford to pay.

Simpler Work, So More for Defense

(Continued from page 56)

---

able chair in a Martin conference room. Your notebook was out again.

Martin had 176 supervisors in the first course; 135 in the second. There are 183 in the class that is just now starting. The men are divided for conference work into groups of 18 to 20.

The original course called for ten meetings. But so little time was left for project work at the end of the course that the number has now been increased to fifteen. The following is a very sketchy outline of the course:

First Meeting. Devoted largely to giving the men an idea of what work simplification is all about. Films are used to show what has been done in other plants. Then, to answer the objection that "this is aircraft, you can't do it any other way," a Martin film showing old and new ways of doing a job.

Second Meeting. Much about the need for the "open mind," how to give and take criticism and suggestions. Followed by a discussion of the procedure for improving methods. Analyzing the objective. Breaking the problem down into its components to determine whether the potential savings are worth the time.

Third Meeting. Takes up the means for recording facts and findings. The tools of work simplification. How to construct a process chart.

Fourth and Fifth Meetings. Members are asked to bring in a process chart of some operation in their own departments. Charts are discussed and analyzed. Who is to do the job? Why is he to do it? When? Where? How? Can the job be eliminated? Can it be simplified? It is at these two meetings that the men really begin to start thinking in terms of needless steps, superfluous motions, waste time.

Sixth Meeting. How work simplifica-

THE SIGNS READ

Dark plain and marbled colors in smooth matte finish make Armstrong's Industrial Asphalt Tile an attractive as well as a practical flooring. The warehouse installation pictured here is a typical use of this heavy-duty, money-saving material. Other uses of Armstrong's Industrial Asphalt Tile include general factory areas, inclined ramps, freight elevators, corridors, and raised semi-exposed platforms.

PRODUCTION costs had been mounting at the factory. Accidents, tool breakage, and delays were directly traceable to faulty flooring. Then Armstrong's Industrial Asphalt Tile was put to work.

It didn't take long for the plant manager to prove he had hired the "right man." To begin with, Armstrong's Industrial Asphalt Tile is made specifically for industrial use. No other flooring material offers as complete a combination of desirable features!

First, this floor is quick and inexpensive to install—and *it's ready for use as soon as laid.* It's a tough, reinforced material, highly resistant to denting. It won't dust or spall. Because it's a mastic, Armstrong's Industrial Asphalt Tile actually *improves* with wear. It cuts cleaning and maintenance bills to the bone. And even the first cost is surprisingly low.

Once Armstrong's Industrial Tile is on the job, production steps up all along the line. Its smooth surface allows faster trucking, easier steering—yet provides ample traction on inclined ramps. And it's a remarkably safe floor, too—nonskid *even when wet,* and non-sparking. Workers like it because it's quiet and comfortable underfoot, free from glare, non-dusting, odorless, and verminproof.

Yes, the plant manager hired the "right man" when he chose Armstrong's Industrial Asphalt Tile. Perhaps it's the "right man" for you. Find out now by writing for your free copy of "Facts You Should Know about Industrial Flooring." Address Armstrong Cork Company, Building Materials Division, 1242 State Street, Lancaster, Pa.

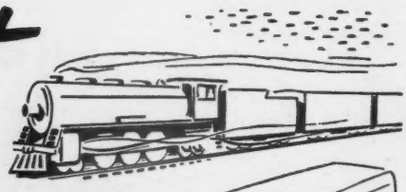
~ ~ ~

ARMSTRONG'S FLOORS

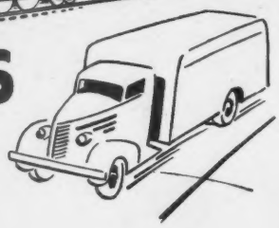
INDUSTRIAL ASPHALT TILE

Rubber Tile - Linotile (Oil-Bonded) - Linoleum - Cork Tile - Linowall Wall Covering

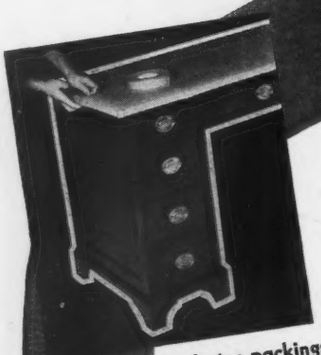
Protect



YOUR PRODUCTS IN TRANSIT . .



Adhesive TAPES



To fasten packings

To hold doors

To seal vents

Here is a fast, economical method to fasten packing material securely in position; to hold doors, drawers and movable parts firmly in place; for sealing vents and openings to keep out dirt and other foreign materials.

Applying SCOTCH Adhesive TAPES is a fast, non-technical operation. Tapes are pressure-sensitive and hold firmly—no moistening or heating required. They are available in a wide range of adhesive properties and variety of backings.

Use coupon below to secure your sample roll.

Made and Patented in U. S. A. by

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MINNESOTA MINING & MFG. CO. Dept. FMM1140
Saint Paul, Minnesota
Gentlemen: Kindly send sample roll of Scotch Adhesive Tape to be used for.....

Name.....

Address.....

City..... State.....

tion principles may be applied to plant layout. Men are taught how to make templet layouts of their departments, how to analyze and correct layout troubles. Difference between product and process control.

Seventh Meeting. Motion study—how it is used in typical work simplification problems. Right-and-left-hand charts are made from film loops, then analyzed.

Eighth Meeting. Discussion of small tools and fixtures. Their place in the work simplification program. How to make and use man-and-machine charts. Motion economy—its principles and applications. Pictures to show how.

Ninth to Fifteenth Meetings. Each section is now broken down into small groups—of 3 to 5 men. Each small group tackles a project. Sometimes their boss suggests one. Project work is most important because it helps the men get the feel of work simplification. With actual practice in conference they can go back on the job and mix it up with any problem that arises.

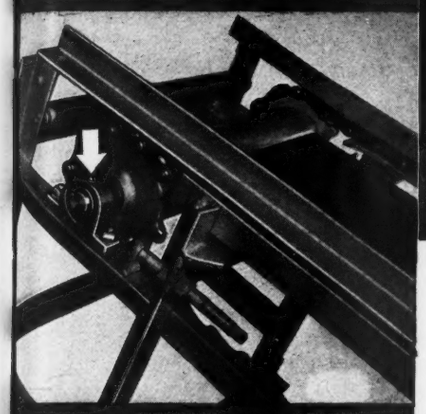
Breakneck but Smooth

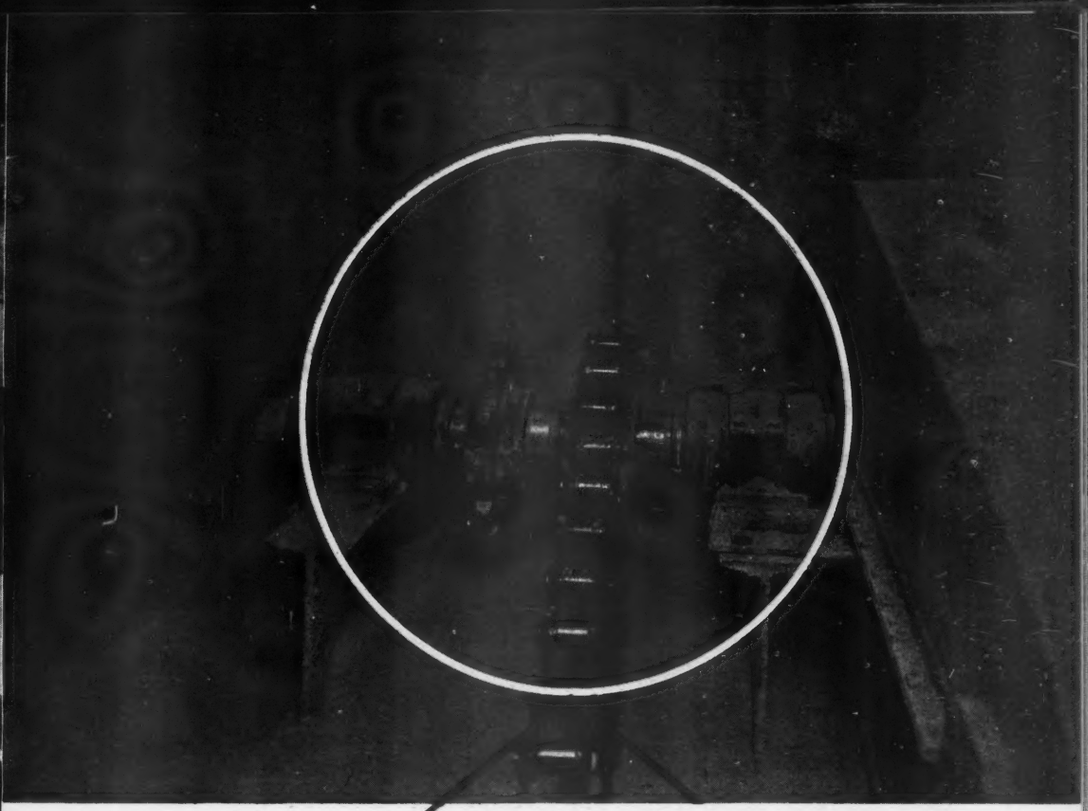
That, with a few verbs and prepositions thrown in to make the sense clear, is how your notes read. You said thanks and good-bye. Bummed a ride back into Baltimore. You had seen 11,000 men striving toward a production capacity designed to assure the nation of maximum numbers of the latest and best aircraft in the world—11,000 men catching the spirit of the great defense effort and breaking their necks to turn out more work.

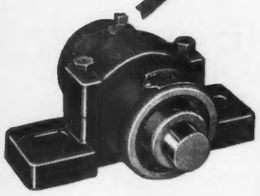
Breaking their necks? Actually working easier but more effectively, taking fewer unnecessary steps, making fewer waste motions. All anxious to do

Key to Wagner Act Quiz

1. T	26. F	51. T	76. T
2. T	27. T	52. T	77. F
3. F	28. F	53. F	78. T
4. F	29. T	54. F	79. F
5. T	30. T	55. T	80. T
6. T	31. F	56. T	81. T
7. F	32. T	57. T	82. F
8. F	33. T	58. F	83. T
9. T	34. T	59. F	84. T
10. T	35. F	60. T	85. F
11. F	36. F	61. F	86. T
12. F	37. F	62. T	87. T
13. T	38. T	63. T	88. T
14. F	39. F	64. T	89. F
15. T	40. F	65. T	90. T
16. F	41. F	66. F	91. T
17. T	42. T	67. T	92. T
18. F	43. T	68. T	93. F
19. F	44. F	69. F	94. T
20. F	45. T	70. T	95. T
21. T	46. F	71. F	96. T
22. T	47. T	72. T	97. F
23. F	48. T	73. F	98. T
24. T	49. T	74. F	99. T
25. F	50. T	75. T	100. T







Turning Points

TO DEPENDABILITY

This well-known cement mill had all your plant's bearing problems – and then some. Kilns were "down" frequently, due to fan bearing failure. Economizer fans, handling hot gases, gave constant trouble, although their bearings were water-cooled. Dust entered big pulverizer bearings and shortened their life. Then, eight years ago, the mill modernized with Fafnirs. High speed fans, blistering hot economizers, and pulverizers with shafts $4\frac{7}{16}$" in diameter have all been in almost constant operation since.

This mill grants the importance of power savings made possible by Fafnirs, but states that, to them, the savings from decreased maintenance and uninterrupted operation count more. Lubricant economy is also a considerable item. And lack of wear on shafts and associated parts has saved them money.

Fafnirs alone combine extremely simple installation with the deeper races and larger balls of the Fafnir Balanced Design – for longer life. Fafnir offers every type and size of radial and thrust bearing, precision bearing, self-aligning bearing, sealed bearing and housed transmission unit to provide the most complete line in America. Write for the "Ten Minute Story" and learn how easily your plant or equipment can "go ball bearing," without costly rebuilding or delays. Distributor stocks in principal cities. The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR

Ball Bearings

THE BALANCED LINE – MOST COMPLETE IN AMERICA

DON'T *let faulty* AIR DISTRIBUTION *slow up your production!*

FAULTY air distribution nullifies the benefits of even the finest air conditioning, air heating or ventilating system because it means drafts, pockets of dead, stale air, hot and cold spots and other uncomfortable conditions that seriously impair the efficiency of workers, cause illness and slow up production.

Today no factory need put up with these undesirable conditions. Ideal air distribution can be assured—and at a surprisingly reasonable cost—by simply equipping all air supply outlets with

ANEMOSTAT *DRAFTLESS* AIR DIFFUSERS

This applies not only to new systems but also to systems already installed because ANEMOSTATS are readily added to existing systems.

These scientifically designed units positively eliminate drafts and equalize temperature and humidity through every conditioned room all the time. They have no moving parts and never need attention or replacement.

ANEMOSTATS have ended air distribution troubles for many factories throughout the country. They'll do as much for your factory.

GET FULL ANEMOSTAT FACTS

Ask your Heating or Ventilating Engineer about ANEMOSTATS or write us direct for descriptive literature.

Typical of the fast growing use of ANEMOSTATS in Industry is this installation in the plant of a Leading Manufacturer of Electrical Equipment.

ANEMOSTAT
CORPORATION OF AMERICA
Dept. F, 10 East 39th Street New York, N. Y.

"NO AIR CONDITIONING SYSTEM IS BETTER THAN ITS AIR DISTRIBUTION"

their share to meet the present emergency.

Why not, when it reduces their efforts and at the same time increases their pay?

There was a single squiggle left in your notes. It turned out to be the word "imagination." It was your final comment on the Martin program. You had seen the principles of work simplification applied with a kind of imagination seldom equaled—an imagination that in spots came pretty close to being inspiration. Once more work simplification properly understood and applied had gone to town.

Wrote "Finis" to Lead Poisoning

(*Continued from page 62*)

on ceilings to a central storage tank.

All well and good. And an effective part of the attack on the lead poisoning hazard. But vacuum cleaners removed the dust *after* the men had been subjected to the danger of breathing it. It was necessary to go a step further and provide a positive means of removing the dust without leaving a chance of its being breathed in by the men.

This was done, after considerable experimentation, by installing what we call a "push-pull" system of ventilation. The theory is to "push" fresh air down over the body and "pull" it (and the dust along with it) out through the floor. Sheet-metal ducts were therefore installed alongside and over the production lines—with narrow slots on the side toward the lines. Floors were then equipped with air ducts built of channel iron with wood-slat covers. A constant stream of fresh, washed air was then played down from the overhead duct, past the body, and out through the floor, forming a curtain of air between the employee and the work. Floor ducts were of course connected with a central suction system and storage tank where the air was washed before being exhausted to outside atmosphere.

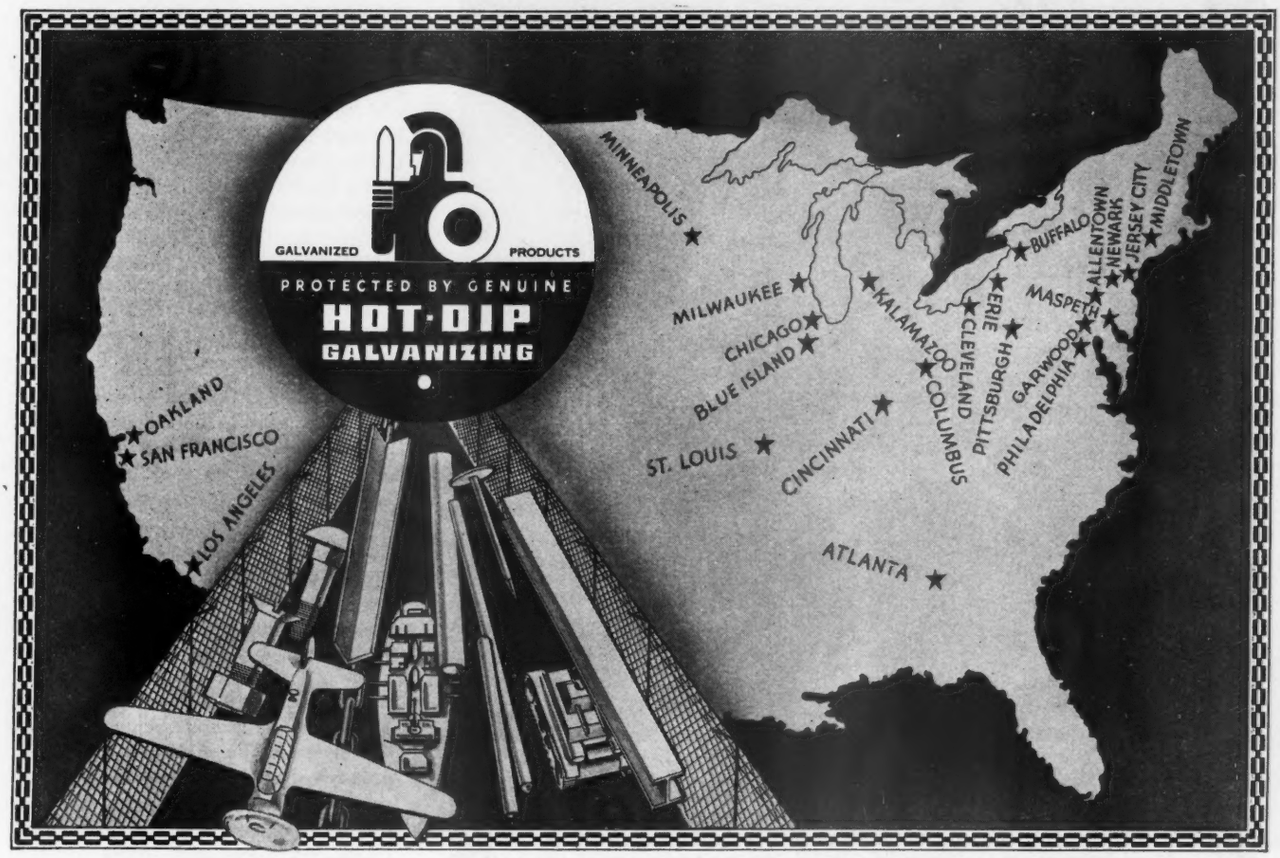
12 to 14 Changes per Hour

Fume removal was approached in similar manner, but with what might perhaps be called "reverse English." I mean lead fumes are lighter than air, so the "pull" part of the system was located over melting pots. To replace air removed by hoods over pots, fresh air was introduced at floor level. Systems were built to give twelve to fourteen changes of air per hour.

Meanwhile we had been experiment-

AMERICAN HOT DIP Galvanizers Association

STRATEGICALLY LOCATED WITH REFERENCE TO STEEL



WHEREVER THERE'S A NEED . . . THERE'S A MEMBER

Rigidly *adhering* to the highest standards of quality at reasonable prices, *maintaining* the most modern and completely equipped shops, *employing* expertly trained personnel, *enjoying* the constant help of an efficient research department, this association represents *the* pioneering, stabilizing anchor of the galvanizing world . . . It is *your guarantee* of getting good work quickly and a genuine Hot Dip Job every time . . . Why gamble—deal with a *known* quality—patronize our very conveniently located members. WE ARE ORGANIZED FOR HIGH SPEED, EFFICIENT PRODUCTION. American Hot Dip Galvanizers Association, Inc., American Bank Bldg., Pittsburgh, Pennsylvania.

IF IT CARRIES THIS SEAL IT'S A JOB WELL DONE

Know the truth about Galvanizing. Write for official specification sheet and new folder giving actual data on life of Hot Dip Galvanized Products under various conditions.

Acme Galvanizing, Inc., Milwaukee, Wis. ★ Acme Steel & Malleable Iron Works, Buffalo, N. Y. ★ American Tinning & Galvanizing Co., Erie, Pa. ★ Atlantic Steel Co., Atlanta, Georgia ★ Buffalo Galvanizing & Tinning Works, Inc., Buffalo, N.Y. ★ Diamond Expansion Bolt Co., Inc., Garwood, N.J. ★ Equipment Steel Products Division of Union Asbestos and Rubber Co., Blue Island, Ill. ★ The Fanner Mfg. Company, Cleveland, Ohio ★ John Finn Metal Works, San Francisco, Cal. ★ Thomas Gregory Galvanizing Works, Maspeth, N.Y. ★ Hanlon-Gregory Galvanizing Co., Pittsburgh, Pa. ★ Hubbard & Co., Oakland, Cal. ★ Independent Galvanizing Co., Newark, N.J. ★ International Derrick & Equipment Co., Columbus, O. ★ Joslyn Co. of California, Los Angeles, Cal. ★ Joslyn Mfg. & Supply Co., Chicago, Ill. ★ L. O. Koven & Brother, Inc., Jersey City, N. J. ★ Lehigh Structural Steel Co., Allentown, Pa. ★ Lewis Bolt & Nut Company, Minneapolis, Minn. ★ Missouri Rolling Mill Corp., St. Louis, Mo. ★ The National Telephone Supply Company, Cleveland, Ohio ★ Penn Galvanizing Co., Philadelphia, Pa. ★ Riverside Foundry & Galvanizing Company, Kalamazoo, Mich. ★ San Francisco Galvanizing Works, San Francisco, Cal. ★ The Sanitary Tinning Company, Cleveland, O. ★ Standard Galvanizing Co., Chicago, Ill. ★ Wilcox, Crittenden & Company, Inc., Middletown, Conn. ★ The Witt Cornice Company, Cincinnati, O.

THIS dial says "When" *automatically!* It has photo-electric control and weighs accurately (and rapidly) batch ingredients of varying kinds and quantities.

Perhaps you don't do batching or proportioning. Even so, the *basic principle* of this versatile control device may help you solve some other weighing or force measuring problem. Remember, it is accurate, rapid and automatic. It saves time and cuts costs.

And it's Toledo-built; more evidence of Toledo's superior engineering knowledge and versatility. It is another of the "45,000 Ways to Weigh"—and that's the title of a new illustrated brochure that you will find interesting, helpful, and time-saving. Send for it.

TOLEDO SCALE COMPANY, Industrial Scale Division, TOLEDO, OHIO

181 Sales and Service Offices in U.S. and Canada.

Is Maintenance Important?

Some companies consider maintenance a necessary evil, others recognize that a well planned program is the best insurance for continuous production and low cost operation.

Some of industry's most highly respected maintenance executives have written their views in recent issues of FACTORY.

If you have not already read these articles, we suggest that you review them because they offer many good sound reasons why maintenance is important.

Read FACTORY's "Maintenance Services" Section every month for tested methods gathered from plants all over America.

ing with a wet grinding booth. Although it was a failure, I mention it here because our experiments ran into several thousands of dollars and maybe we can save other people some money by giving them the benefit of our experience. We had started to take tests with an impinging apparatus to determine dust counts. If dust could be trapped in an impinger, why not trap it as generated in an impingement type of booth? Well, it didn't work out that way. We finally took the water out of the booth and put in the push-pull system. I should add that we stopped all lead grinding and went to hand operation with the exception of one wet grinding job which lent itself readily to the use of a mechanical grinder with a water supply line attached to the air supply, the idea being to wet the dust as soon as it is generated.

Monthly Blood Tests

Further to safeguard the health of employees, studies of the men's blood are made monthly. Every man in the area, regardless of operation, is subjected to this examination, which has been one of the main factors in the control of occupational hazards in our plants.

Let me finish by saying that our product engineering division has also made extensive studies for the purpose of eliminating operations that endanger the health of employees. This work has been going on ever since the advent of the steel body, and much progress has been made toward designing a body that can be manufactured without the need for coating seams and joints with solder or other foreign materials.

Materials Are Analyzed

No grinding was done on solder surfaces except in the above-mentioned booth with the push-pull ventilation. This booth is entirely enclosed, with fresh air supply at ceiling and strong exhaust at floor. In addition the grinder was rotated in the direction that would throw any particles directly toward the floors.

As I said at the outset, we haven't had a case of lead poisoning in the last three years. To keep up this perfect record, our industrial hygiene engineering department makes constant analyses of abrasives, compounds, chemicals, and acids used in the manufacture of automobile bodies. Air analyses are made to get dust counts, and charts are constructed to show amounts of dust to which employees may be exposed without endangering their health.

What the Employee Expects of His Employer

HAROLD SCHOEBERLEIN

Brake Operator, All-Steel-Equip Company
Aurora, Ill.

The author first presented this article as an address before the Aurora Rotary Club. FACTORY *publishes it because it is an illuminating exposition of what's on the worker's mind.*

AS A GROUP of business and professional men, it is always interesting and important for you to know what an employee expects of his employer. Does the employer offer too little or does the employee expect too much? In the next few minutes I shall try to explain to you some of the expectations of a factory employee. I have outlined these under the following headings:

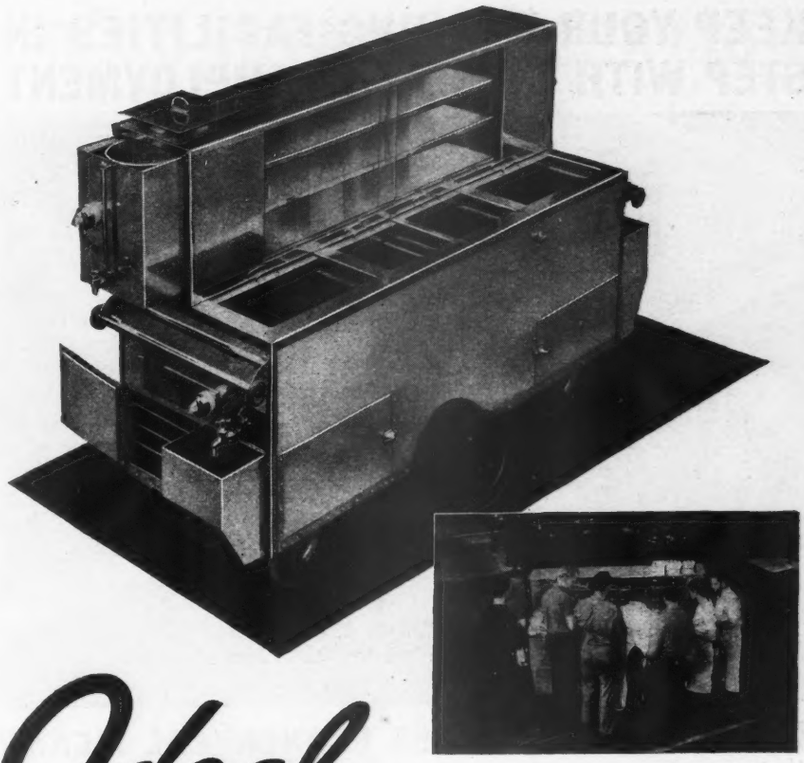
1. Health and safety.
2. Wages.
3. Working conditions.
4. Supervision and promotions.
5. Relations between employee and employer.

Health. Henry Ford, when asked what kind of workmen he preferred, answered promptly and decisively, "Healthy workmen." And so it should be with all employers. But, the employee expects his employer to do all in his power to safeguard his health. How can this be accomplished? The employer should see that the plant is well ventilated, that it is always kept clean, that there are adequate sanitary conveniences—and yes, if it is at all possible, even shower rooms. He should see that his plant has proper lighting facilities wherever night work is undertaken.

Have Safety Engineer

Safety. Punchpresses, shears, and other kinds of machines have all taken their toll in fingers, hands, and arms, and employees expect their employers to take proper steps to prevent this. Punchpresses should be made to operate by the use of both hands. Employees expect the employer to have a safety engineer whose job it is to make and furnish the most modern and approved safeguards for machines and tools. No man should even be allowed to climb a ladder unattended, and men having jobs involving the safety of others should undergo periodic special examinations by doctors.

Wages. The average employee favors a bonus system with a fair hourly rate. With incentive and bonus, no factory management should have any difficulties



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Ideal Conveyors are built in many standard designs and types. Special requirements are readily served by built-to-order units. Our large experience in this field is yours to command for counsel or recommendation. Our booklet "Human Beings At Work" will open your eyes to an important phase of industry you may have overlooked. Write for it.

THE SWARTZBAUGH MFG. COMPANY
Toledo, Ohio, U. S. A.
DISTRIBUTED BY THE COLSON CORPORATION, Elyria, Ohio

Is Maintenance Important?

Some companies consider maintenance a necessary evil, others recognize that a well planned program is the best insurance for continuous production and low cost operation.

Some of industry's most highly respected maintenance executives have written their views in recent issues of FACTORY.

If you have not already read these articles, we suggest that you review them because they offer many good sound reasons why maintenance is important.

Read FACTORY's "Maintenance Services" Section every month for tested methods gathered from plants all over America.

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Employee Relations, Labor	Buildings & Services
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Factory Management and Maintenance

330 WEST 42ND ST. NEW YORK, N. Y.

with employees. On the basis of what I have outlined above, the length of service of employees with the company would increase, which is, of course, of material benefit to an employer.

Citing the company by which I am employed, the average length of service is 7.1 years. This proves why an employee does not need CIO or AFL to enable him to get a living wage, or outside assistance to compel an employer to give him proper wages and treatment.

Working Conditions. In my associations with employees of other factories, one of the main topics of discussion is the fault of night work. The general feeling of the men is that nights were not made to work in, but due to business conditions and the necessity of increasing production, this is necessary. An employee expects his employer to try to stagger his shifts. Night-shift employees should get extra bonus.

Stagger Night Work

When night work is staggered, an employee becomes better acquainted with the day foreman, who usually is the senior foreman, and the employee may get new ideas and learn company policies more quickly and better, in addition to mingling with a different group of fellow employees. This also gives him some time to spend with his family.

Employees will stay with the firm where seniority is enforced. I refer to slack times. Naturally, when times are such that an employee has no trouble finding employment, he does not give seniority the consideration he should. An employer should stress the need of seniority so that faithful employees will have employment in slack times.

Supervision and Promotions. The employee expects his employer to put men at the head of departments who have job knowledge, who are able to plan and distribute work, and, probably most important of all, are able to handle men. The foreman should secure and give cooperation. He should see that he has the proper equipment. A foreman should aid his men by giving them some of the skill that he should possess. He should have no favorites and should treat all men alike. He should know the one best way to do a job and should impart this knowledge to his men. He should not be content to hand out job instructions without subsequent supervision. This last point causes more trouble than any other. In most cases foremen pass out work, the man does the job without further supervision; then the foreman comes around and finds the job has been done wrong. Who is to blame?

As you train the sapling, so will the tree grow. This also applies to the training an employee receives from his su-

"A RECORD FOR CONSTANT OPERATION"

Trouble-free turbine means trouble-free operation for prominent fuel company.

A case history showing the trouble-free service you can expect wherever you see the Coppus **BLUE RIBBON**

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To insure consistently dependable operation of turbine-powered equipment, write "Coppus" on your specification. The "blue ribbon" painted on the flange indicates:

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2. **ENCASED GOVERNOR**—slow speed, leverless.
3. **SEPARATE SAFETY TRIP**—pilot-operated, leverless.
4. **PARTIAL LOAD ECONOMY**—by individual nozzle control.
5. **DYNAMOMETER TESTED**—before shipment.

During 1939, 87% of orders for Coppus Steam Turbines were repeat orders. Bulletin 135-9 describes vertical and horizontal types; also with built-in speed reducer. Steam, air or gas-operated. Write for this bulletin today.

H. P. not E. P.* for small H. P. jobs.

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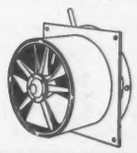
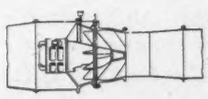
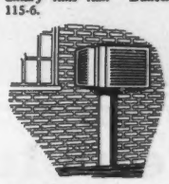


COPPUS-DENNIS FANMIX GAS BURNER. New method of mixing gas and air insures perfect gas-air ratio–instant, complete combustion. Bulletin 410-2.



COPPUS VANO BLOWERS. 1001 uses. High efficiency on special installations where ordinary fans fail. Bulletin 115-6.

COPPUS CABLE MANHOLE AND TANK VENTILATORS. For any confined working space. Special adaptions for boilers, tank cars, shipholds. Bulletin 163-1



COPPUS AIR FILTERS. For engines and air compressors. Perfect, uninterrupted filtration. Bulletin F-310-4.

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PATIENT:
An 8 foot fan ventilating an entire Central Office Building.

CASE HISTORY:

(a) *Ailment.* Bearing burned out and 5 inch shaft supported by bearing badly scored.

(b) *Condition.* Replacement of shaft difficult and expensive due to cramped fan installation.

(c) *Previous Treatment.* New bearing installed. Threw oil badly. Shims between sleeves removed and tighter fit effected. Oil leakage present. Heavier oil tried without improvement.

(d) *The Cure.* To the two quarts of oil which the bearing holds was added two ounces of "DAG" COLLOIDAL GRAPHITE Fan was run intermittently for a total of 60 hours over a three week period. Leakage still apparent. Shims again removed and fan run for 100 hours over a three week interval. Overheating and leakage disappeared.

(e) *Patient Discharged.* Fan now operating 24 hours a day and has been doing so since March 13, 1940. A permanent cure of a stubborn case without need of shutdown and expensive repairs.

In the above, the graphite formed a self-lubricating, "stay-put" surface on the friction parts which permitted maintenance of the seal. Write for Bulletin 112.

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As one reader put it—"I consider the advertising pages of FACTORY a most useful source of information on the latest developments in equipment and materials."

pervisor. Every employee with any kind of foresight will look forward to the time when he will be called upon to fill his foreman's shoes. In other words, the average employee looks forward to promotion and will train himself along those lines in the hope that he will be selected when promotions are in order. We have concrete examples of this in the firm where I am employed—where shear helpers have been advanced up the line and now have responsible office positions.

Relations Between Employee and Employer. Give an attentive ear at all times to employees suggestions, and complaints about such things as incorrect application of standards. State what you will do, and when you will do it. All of these things develop confidence in your employees.

If the management would have regular meetings with its employees, outlining the business trends, giving the employees information as to what an employer has to contend with in coping with our present industry-opposed national administration, the employee would then be more inclined to agree with the management as to what candidate and party is of mutual benefit to employee and employer.

In closing may I say that if we try to live up to the golden rule of "Doing to others as we would have others do unto us," this would undoubtedly be a better place in which to live and work—for both the employee and employer.

•

BOOKS

LITTLE BITS ABOUT BIG MEN

B. C. Forbes, President, B. C. Forbes Publishing Co., Inc., 120 Fifth Ave., New York. 223 pages, index. $2.50.

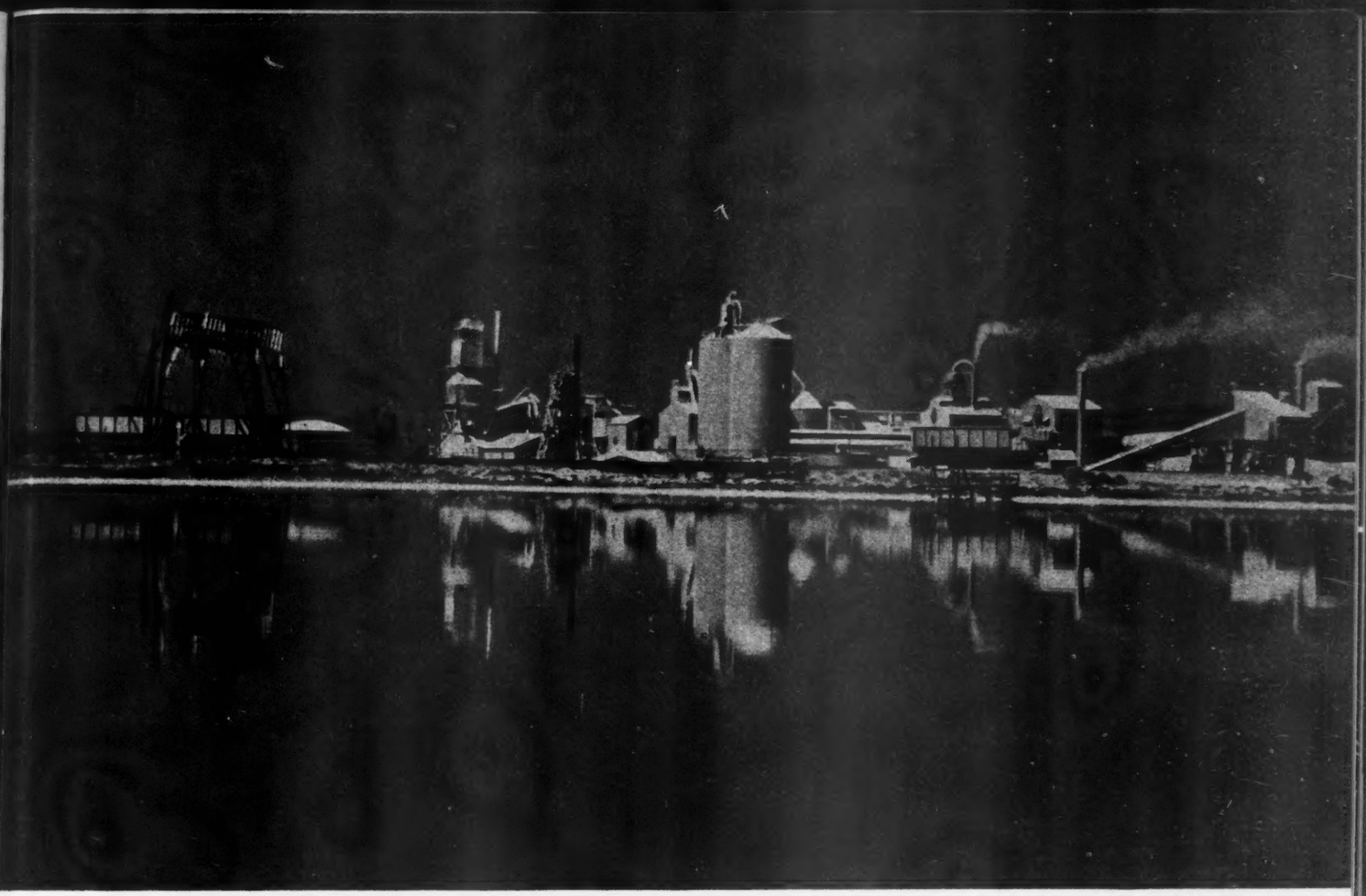
Quick sketches of approximately 260 important business leaders and personages of the 20th century contain humor and an off-the-record breeziness that makes them delightful as well as informative reading. Such men as J. P. Morgan, Knudsen, Mellon, Woolworth, Edison, Stettinius, Kettering, Willkie, Woodruff, are, of course, included.

INDUSTRIAL MANAGEMENT

Richard H. Lansburgh, formerly Professor of Industry, University of Pennsylvania; William R. Spriegel, Associate Professor of Industrial Management and Chairman of the Department of Management, Northwestern University, School of Commerce. John Wiley & Sons, Inc., 440 Fourth Ave., New York. 666 pages, illustrations, tables, bibliography, index. $4.50.

Third edition. Aim of the first edition in 1923 was to set forth a coordinated simple treatment of the problems, ideals, and methods of successful management and to indicate the responsibilities of factory executives to workers, stockholders, and community. Stress was placed on general organization problems. Revision in the form of this third edition includes the shift in emphasis on managerial technique, considers external social influences and recent trends in technical details.

(*Continued on page 166*)



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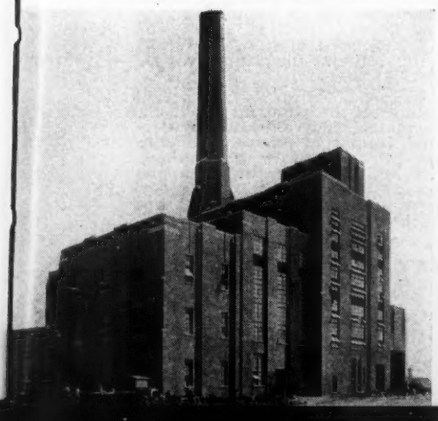

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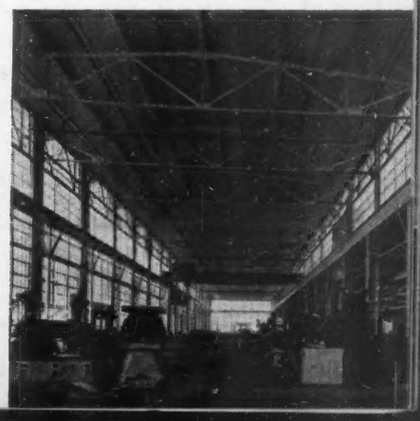

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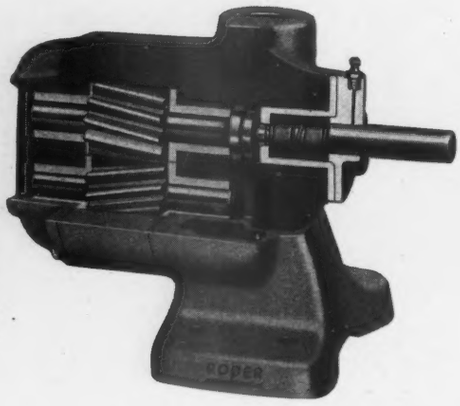

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Use them. Tap the valuable information thus easily made available to you.

(Continued from page 160)

Emphasizing the social and personnel aspects of industrial organization and management, the authors desire to present a "sound philosophy of management which may be summarized as a balanced relationship between the equities of the consumer, labor, owners of capital, management, and organized society or government."

1941 A.S.M.E. MECHANICAL CATALOG AND DIRECTORY

The American Society of Mechanical Engineers, 29 West 39th St., New York. 501 pages. $3.

Indexed and cross-indexed, filled with specification data, application data, and illustrations, the 1941 Catalog consists of a catalog section, a directory, a trade name section, and a section of A.S.M.E. codes, standards, periodicals, and other publications.

ADJUSTED CAPITALISM

Curtis H. White. The Christopher Publishing House, 1140 Columbus Ave., Boston. 66 pages. $1.25.

A special national revolving fund of money will, the author believes, help solve our present economic ills. In discussing the causes of business depression and in proceeding to the application of his general principles to unemployment, large scale investment, government borrowing, he shows wherein this special fund fits and how it is to work. The idea is to bring business back into adjustment and to keep it there by means of this fund whose function is to induce the spending of surplus funds on new investments.

WARTIME CONTROL OF PRICES

Charles O. Hardy. The Brookings Institution, Washington, D. C. 216 pages, index. $1.

Investigation undertaken at the request of the United States War Department, as the country embarks upon an emergency defense plan, considers whether a price inflation similar to those of former times is again inevitable and whether it is possible to devise methods of financing the program and controlling prices so as to prevent a repetition of past experiences. Part I is an analysis of the problems of price control in time of war. Part II consists of a review and appraisal of price controls developed in the United States during the last World War.

ECHOES FROM MOSCOVY

A. Polarski Barski. Translated by Prof. Ramo Mayyahk, Late of the University of Moscow. The Christopher Publishing House, 1140 Columbus Ave., Boston. 59 pages. $1.25.

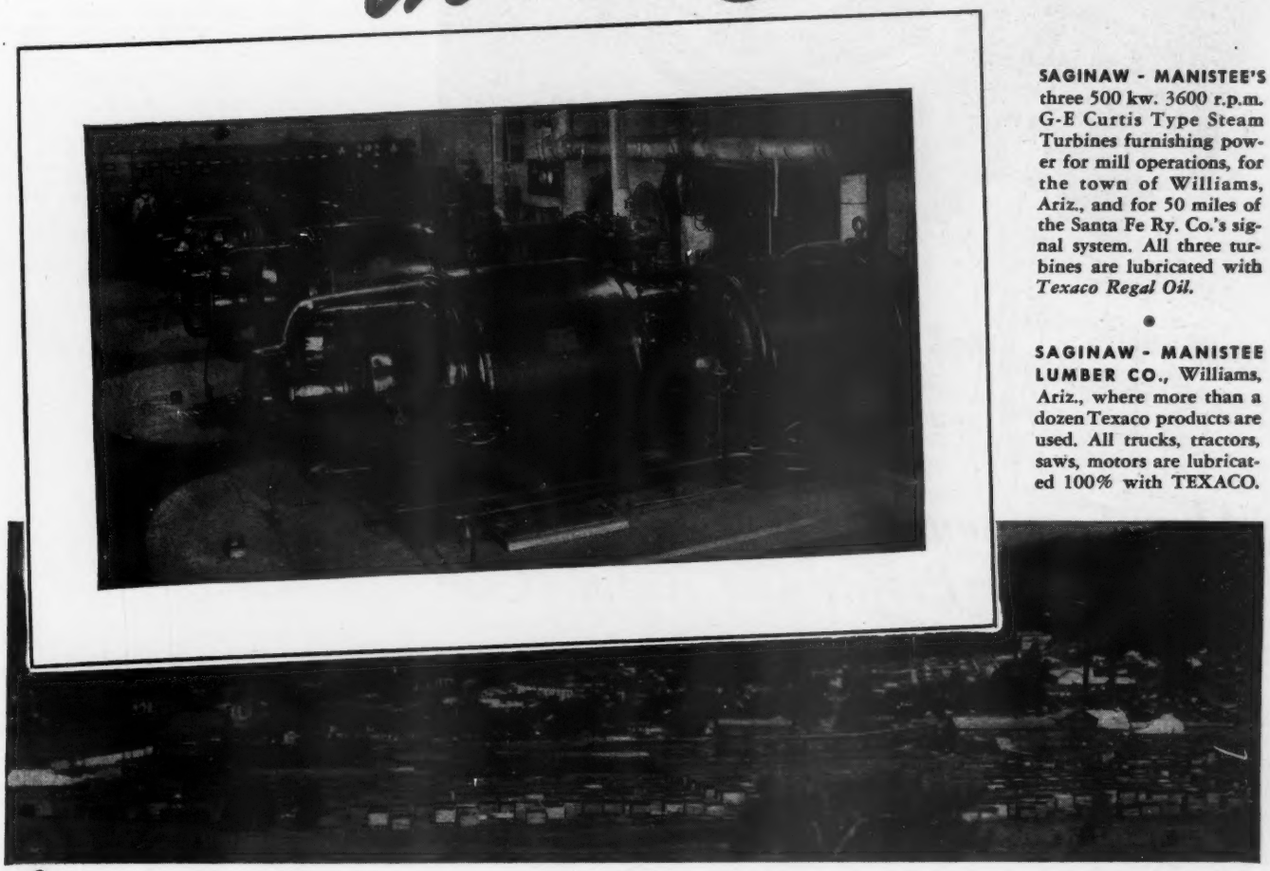
Thinly veiled sarcasm for the New Deal, its policies and accomplishments, is the prevailing note in this "Russian Rhapsody" that seeks to expose New Deal fallacies and the Brain Trust for what the author thinks they are. Written in poetic form, the book has three main parts: The Muscovites in Utopia; The Enchanted Knights of the Deal Table; The Magic of Merlin, and His Wonder-Workers.

PUMPS

Frank A. Kristal, Licensed Professional Engineer, New York; New York District Manager, Weinman Pump Mfg. Co. and Roots-Connersville Blower Corp., Turbine-Pump Department. F. A. Annett, Associate Editor, *Power*. McGraw-Hill Book Co., Inc., 330 West 42d St., New York. 339 pages, illustrations, diagrams, graphs, tables, index. $3.50.

Those interested in pumping problems will find herein considerable information on types and designs of pumps available, applications to which they are suited, their service limitations. Important applications such as boiler feed, sewage, deep wells, sumps are treated in a separate chapter. Such operating problems as esti-

BEARINGS "EXCELLENT" *in all 3!*



SAGINAW - MANISTEE'S three 500 kw. 3600 r.p.m. G-E Curtis Type Steam Turbines furnishing power for mill operations, for the town of Williams, Ariz., and for 50 miles of the Santa Fe Ry. Co.'s signal system. All three turbines are lubricated with *Texaco Regal Oil.*

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SAGINAW - MANISTEE LUMBER CO., Williams, Ariz., where more than a dozen Texaco products are used. All trucks, tractors, saws, motors are lubricated 100% with TEXACO.

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The lubricant used exclusively in this power plant is *TEXACO REGAL OIL.*

Highly resistant to oxidation, emulsification and sludging, *Texaco Regal Oils* keep turbine lubricating systems clean, and bearings operating at normal temperatures. They separate rapidly from air and water. With proper care, *Texaco Regal Oils* assure years of effective lubrication at low cost.

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FACTORY MANAGEMENT *and* MAINTENANCE
330 WEST 42ND STREET NEW YORK CITY

mation of the size head against which the pump must work, size of suction and discharge pipes are discussed. Extensive treatment has been given to pump installation, operation, and supervision, and troubles and their remedies. The authors have not tried to cover every special type of pump available.

ADMINISTRATIVE PROBLEMS OF EMPLOYMENT SERVICES IN EIGHT STATES

Oscar Weigert, Associate Professor of Comparative Social Legislation, The American University. Public Administration Service, Publications Division, 1313 East 60th St., Chicago. 50 pages, $1.

Dealing primarily with the public employment service, this study covers 8 out of 51 jurisdictions in its attempt to show the essential difficulties and to suggest some of the fundamental advantages of a federal system in so large an undertaking. The "national system" of employment offices, the state services, local organization of the services, internal organization of local offices, integration of compensation activities with local employment offices, supervision of local employment offices, and personnel problems are the main topics discussed.

PUNCHED CARD METHODS IN SCIENTIFIC COMPUTATION

W. J. Eckert. The Thomas J. Watson Astronomical Computing Bureau, Columbia University, New York. 136 pages, illustrations, diagrams, index. Cloth—$2., paper—$1.75.

Purpose is to show the possibilities of the Electric Punched Card Method, known also as the Hollerith or Electric Accounting Machine Method, in scientific computation. It is not a manual of operation for the various machines, but is designed to enable a scientist so to formulate his problem that any skilled operator of the machines can carry it out. The use of this method in physical science has been confined largely to astronomy. Part I deals with the punched card method, Part II with machine methods, Part III with astronomical applications.

●

ON THE CALENDAR

NOVEMBER

8–9, National Time and Motion Study Clinic, Third Meeting, Chicago. W. F. Entorf, Publicity Chairman, Industrial Management Society, 421 Engineering Building, 205 West Wacker Drive, Chicago.

12–13, Air Hygiene Foundation, Fifth Annual Meeting, Pittsburgh. Air Hygiene Foundation, 4400 Fifth Ave., Pittsburgh.

12–13, American Management Association, Production Division, Autumn Conference, Cleveland. H. J. Howlett, Secretary, 330 West 42d St., New York.

DECEMBER

2–5, American Society of Mechanical Engineers, Annual Meeting, New York. C. E. Davies, National Secretary, 29 West 39th St., New York.

2–7, Fourteenth National Exposition of Power and Mechanical Engineering, New York. Charles F. Roth, President, International Exposition Company, Grand Central Palace, New York.

5–7, Society for the Advancement of Management, Annual Meeting, New York. Miss Evelyn Buckley, Secretary, 29 West 39th St., New York.

9–13, National Association of Manufacturers, Annual Meeting, New York. Noel Sargent, Secretary, 14 West 49th St., New York.

MARCH

24–29, American Society of Tool Engineers, Machine Tool and Progress Exhibition, Detroit. Ford R. Lamb, Executive Secretary, 2567 West Grand Blvd., Detroit.

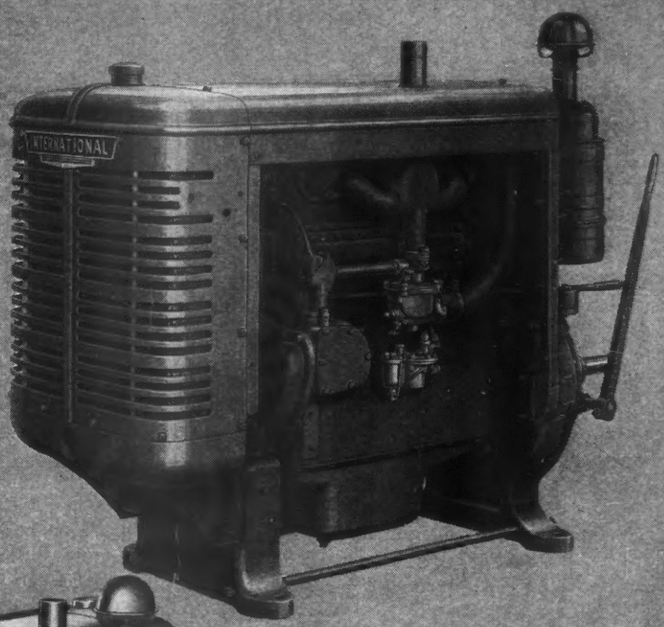
New International
POWER UNITS

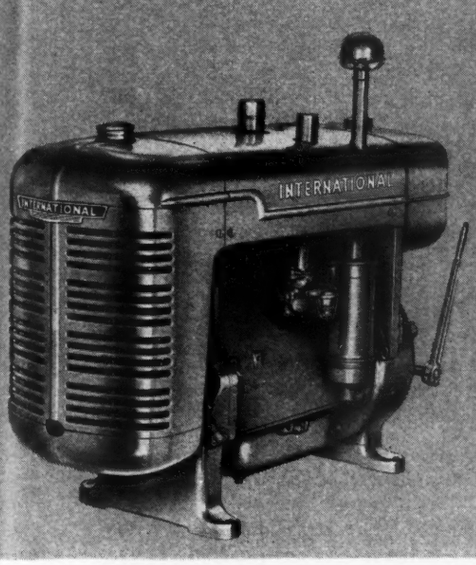
RIGHT: U-6—41 h. p. at 1,500 r. p. m.

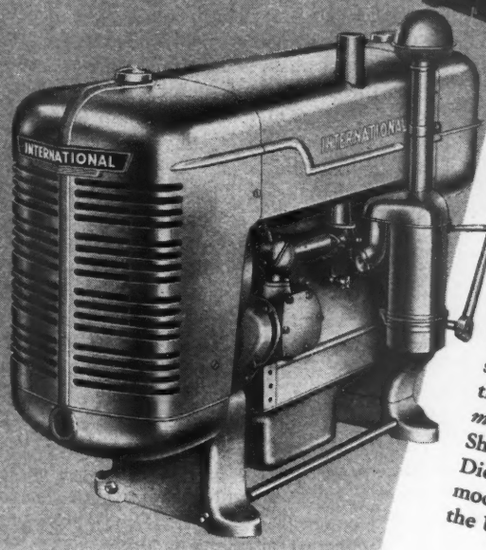
CENTER: U-4—31½ h. p. at 1,800 r. p. m.

BELOW, LEFT: U-2—22 h. p. at 1,800 r. p. m.

Operating on Gasoline

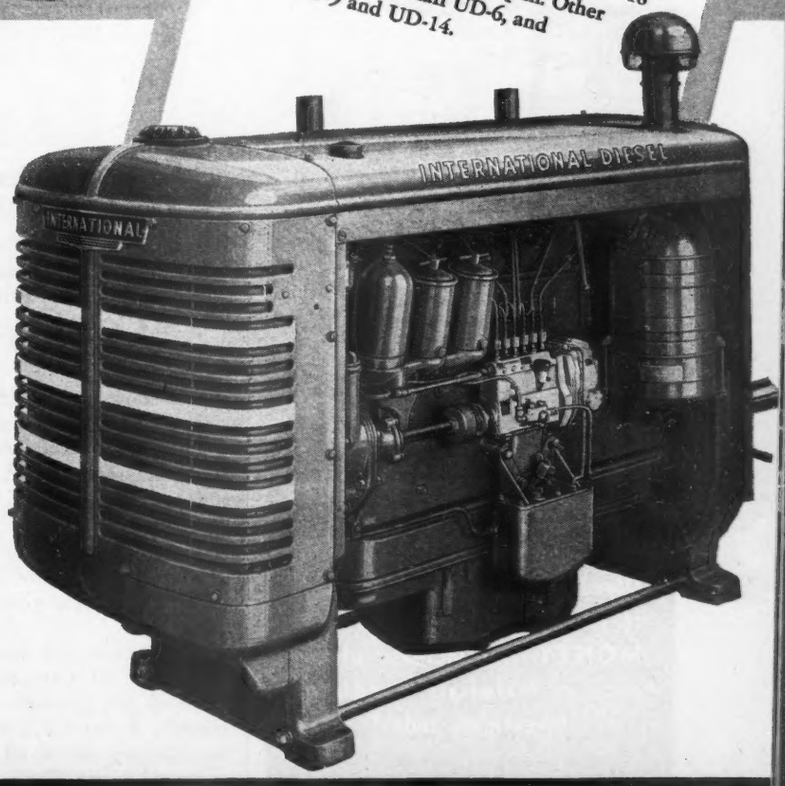






Also—Four New International DIESELS

• In addition to the new carburetor-type engines, the International line also includes Four New Diesel Power Units. They provide smooth, low-cost Diesel Power in compact, convenient form—easy to install, simple to operate, and quick and easy to start. They are engineered all the way through for *economy of operation and maintenance*, and *long heavy-duty service*. Shown below is the big 6-cylinder UD-18 Diesel—100 h.p. at 1,400 r.p.m. Other models are the small UD-6, and the UD-9 and UD-14.



THESE NEW INTERNATIONAL POWER UNITS are 4-cylinder engines, readily adapted to a wide variety of jobs. They bring *new efficiency* and *new economy* in their power range. Their *quality construction* pays out on the job in terms of low operating and maintenance cost, long life, and stamina to stand up under 24-hour-a-day operation.

Among the many features that prove of great value for all kinds of work are: Valve-in-head design, replaceable cylinders, full-floating piston pins, efficient combustion control, pressure lubrication, Tocco-hardened crankshafts, precision-type main bearings, and efficient cooling. Basic parts can be attached or removed without interfering with other parts, making possible many equipment combinations to meet individual needs.

The nearby International dealer or branch will give you complete information on the New U-2, U-4, and U-6, and other International Power Units ranging up to 110 max. h.p. All carburetor-type engines in the line operate on gasoline, gas, distillate, and kerosene.

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They Say and Do

Arbitration Called Solution to Defense Disputes

Viewing labor disputes as a menace to the national defense, The American Arbitration Association has offered its service anew to management and labor.

"These are the days when neither men nor nations can any longer afford the high costs and extreme wastes of disputes," the association declared. The insertion of an arbitration clause in labor contracts was urged as insurance against the waste and risk of strikes.

In the presence of such a clause, the association pointed out, a dispute cannot go to public trial since the courts insist that arbitration be held before suit can be started. Thus, the dispute is settled privately, by experts, immediately, and amicably.

"The American Arbitration Association was created by business men," the announcement concludes. "They maintain a uniform voluntary arbitration system, available day or night in 1,600 American cities, and another one throughout South America. The association offers its services, machinery, modern equipment, and intelligence to every business man or organization that will do its share in driving disputes out of its own territory and in removing this menace to American economic unity and national solidarity and preparedness."

•

U. S. Consultant Describes Swiss Training Method

In the final, frenzied days of the war, France turned to the methods of Dr. A. Carrard, Swiss industrial training expert, in a belated attempt to replenish the neglected ranks of its skilled workers.

The effort was effective as far as it went, says K. B. White, American industrial consultant who has recently returned from abroad. Carrard made capable milling machine hands out of laborers, carpenters, and chocolate workers in 38 days and turned a carpenter into a highly skilled assembly fitter in 35 days, which, in France, is fast work.

Space does not permit a detailed description of Carrard's methods, but some of his principles are worthy of remark. A psychologist, he believes in the elimination of all theory and all technical terms. Tools, he says, should be defined by use only, and the movements of different trades should be subdivided into as many elementary operations as the trainee can grasp at one time.

Carrard attacks school methods as the opposite of good training because they teach children *not* to help each other. In some cases he has used one group of trainees to instruct the group next behind it in an operation that the first group has just learned.

From the first day, Carrard trainees enjoy the proud feeling of doing useful work. Their interest in learning is kept at its peak at all times. Carrard has found that learner interest and progress fall off rapidly after 30 minutes of practice at one operation. Accordingly he switches his trainees from one task to another at half-hour intervals.

•

Hopeful Views Expressed on Defense Economy

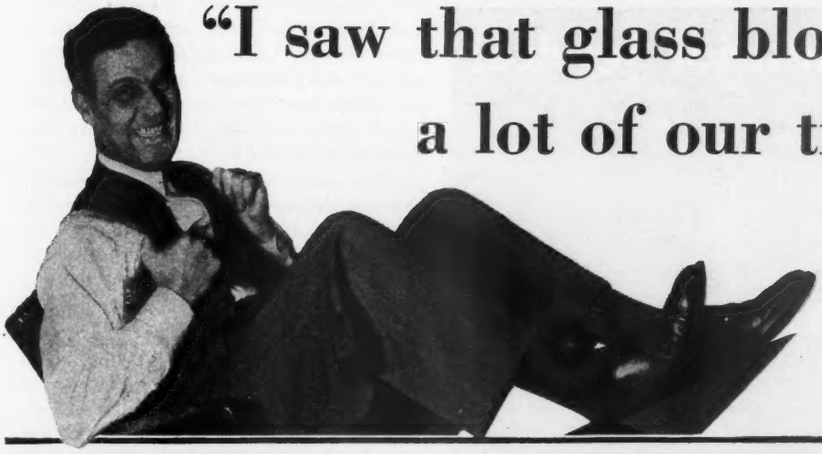
Optimistic, by and large, were the comments of several of America's foremost industrialists and economists when they spoke recently on the nation's economic prospects under the new defense program. All were guests of General Motors Chairman Alfred P. Sloan, Jr., and the theme of their talks was "Mobilizing America's Economic Strength."

The speakers included William S. Knudsen of the National Defense Advisory Commission, Dr. Sumner Slichter, Harvard University economist, Dr. Harold G. Moulton, president of Brookings Institution, Paul G. Hoffman, president of the Studebaker Corporation, Charles F. Kettering, General Motors research vice-president, and Mr. Sloan.

American surpluses, both of men and materials, give it the reserve power to take the defense program in stride, most of the speakers agreed. The essential problem, in Mr. Sloan's opinion, is to increase the national income through increased productivity, superimposing defense work on normal industrial activity rather than allowing one to supersede the other. He set $80,000,000,000 a year as the national income figure that would probably provide ample margin for defense needs.

Mr. Knudsen expressed confidence in industry's ability to carry through the defense program on time, but warned that machine tools constituted a critical factor. Here Dr. Slichter offered a note

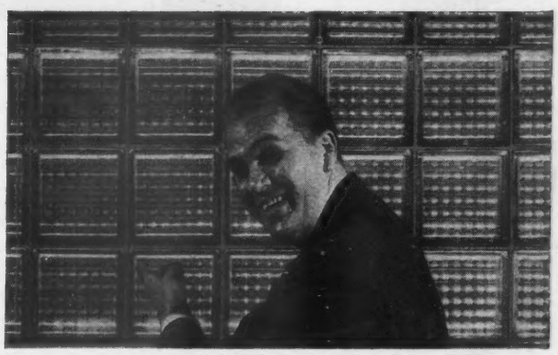
"I saw that glass blocks could lick a lot of our troubles



. . . that's why the trip through Jackson's plant was the best day's work I ever did."

← **"CORRODING AND ROTTING SASH** have always been a headache for us. We have an acid atmosphere that eats the sash and means a big bill for maintenance. Jackson showed me a section of sash in their old plant—then he showed me how they answered that problem in the plant they just remodeled.

→ **"GLASS BLOCKS** cut their maintenance costs because neither the blocks nor the mortar joints in the panel are harmed by the acid, humid atmosphere. And Jackson says that their cleaning bill is less, because the big panels of PC Glass Blocks are so easy to clean.



"TEMPERATURE AND HUMIDITY CONTROL are a lot easier with glass block panels in place of regular windows. Even in cold weather it is warm near the panels, because the glass blocks have such a high insulation factor—more than twice that of ordinary windows. It helps Jackson keep his product more uniform, makes the adjustment of precision machinery less frequently required, and makes workrooms far more comfortable.

"THERE'S A LOT OF LIGHT in Jackson's new plant. It's a soft, diffused light. Jackson has panels of special light-directing blocks that direct natural-color daylight on working areas far within the room. PC Glass Blocks certainly pack a lot of advantages in a single product. I'm glad I saw what they can do before we started our new plant."

IN hundreds of plants all over the country, PC Glass Blocks are helping to reduce maintenance costs, improve production and provide better daylighting. Hardly an industry exists that can not benefit from the practical advantages of this modern light-transmitting material.

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of hope by pointing out that even in this respect America is better off than it was 20 years ago because manufacturing output has increased only four-fold while machine tool capacity has increased five-fold.

Not long afterward, in a Chicago speech before the American Institute of Meat Packers, Dr. Moulton expressed belief that a rise in the national income to $80,000,000,000 may be expected in a year or so. And in Cincinnati, Tell Berna, general manager of the National Machine Tool Builders Association, announced an exciting new example of industry's ability to meet the challenges of national need. He referred to the machine tool industry's development of a shell machine capable of turning a shell a minute. This tremendous advance in production methods was produced by the industry in response to a request from the War Department.

•

Silver Dollar Payroll Impresses City

Neat bags of silver dollars were handed to 1,400 employees of the Thermoid Company, Trenton, N. J., recently, instead of the customary pay envelopes. The Chamber of Commerce helped merchants to keep track of the 40,000 "cartwheels" as they began to penetrate every local artery of trade. Soon landlords, grocers, druggists, bakers, theater owners, and even farmers had a convincing demonstration of the way in which the money acquired from the sales of an industry's products throughout the world is brought back for local distribution through the industry's payroll.

•

Industry's Research Challenge Defined in Survey

Wanted: a procedure for dispelling fogs locally over airports; a $200 automobile for transportation only; a unit for absorbing solar energy so that power thus obtained could be used to operate mechanical devices; a food container requiring no tin; a main line diesel freight locomotive initally as cheap as a steam locomotive—and 581 other devices touching every field of industrial and economic endeavor from aeronautics to agriculture.

The Research Advisory Service, which is maintained by a group of banks, recently completed a survey in which 1,042 leading industrialists were asked:

"What new product, process, or material might industrial research develop that would be valuable to your industry?"

At the suggestion of Edward R. Stet-

tinius, Jr., of the National Defense Advisory Commission, the 586 different answers to this question were reviewed by the National Inventors Council, and the items most urgent for national defense were indicated. The results of the survey were published in a booklet, "Industry's Challenge to Research," to serve as "an informal blueprint for the research worker and the executive who decides on bringing out new products."

•

Industrial Relations Called Major Defense Problem

The necessity for better industrial relations will increase, rather than diminish as the defense program gets under way. This, at least, is the conjecture of Harold H. Swift, vice-chairman of the board, Swift & Company.

"The smooth and efficient functioning of production and distribution will have a great bearing on our ability as a nation to meet the serious problems of the future," he told the Boston Conference on Distribution. "I firmly believe that all though the jolts and dislocations of present preparedness and possible war, the personnel problem in our plants and factories may be the biggest problem."

Industrial relations, Swift said, should not be considered as a palliative or a cure-all in a crisis but as a preventive. The worker's chief interest is not in his pay check but in being considered as an individual.

•

Employers Urged to Aid Alien Registration

Alien registration proceeds apace, but it is by no means complete. The Department of Justice, in charge of the job, reports that industrial employers have been helpful and suggests that all firms check to make sure that non-citizens on their payrolls have been registered.

Director Earl G. Harrison, of the Department's Alien Registration Division, points out that the sympathy and advice of employers can do much to dispel any fears an alien may have about registration, particularly with respect to security of employment.

"Inasmuch as an alien is subject to $1,000 fine or six months' imprisonment if he does not register by December 26, employers have a direct interest in helping their non-citizens to comply with the law," he says. "Informational literature pertaining to the alien registration program will be sent on request to any employer in the United States. Such requests should be addressed to the Alien Registration Division, Department of Justice, Washington, D. C."

Clean Your Machinery on the Floor

Greasy, oily, dirty machines which invite accidents, promote inaccuracy, and encourage carelessness would in most plants, be kept clean if the job could be done easily and quickly without long shut-downs or dismantling. You can clean most machines right on the floor by the easy, dependable, speedy and safe method made possible by

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You spray on Magnusol solution, let it soak a few minutes, then hose off with water. All grease and dirt flush off with the water, leaving completely clean surfaces even in the hard-to-get-at locations. Painted surfaces look like new. Finished metal surfaces are bright and film-free. Such surfaces are usually dried off with compressed air to avoid the possibility of rusting. Magnusol is safe, harmless, non-poisonous and above all, non-inflammable. It deserves careful investigation.

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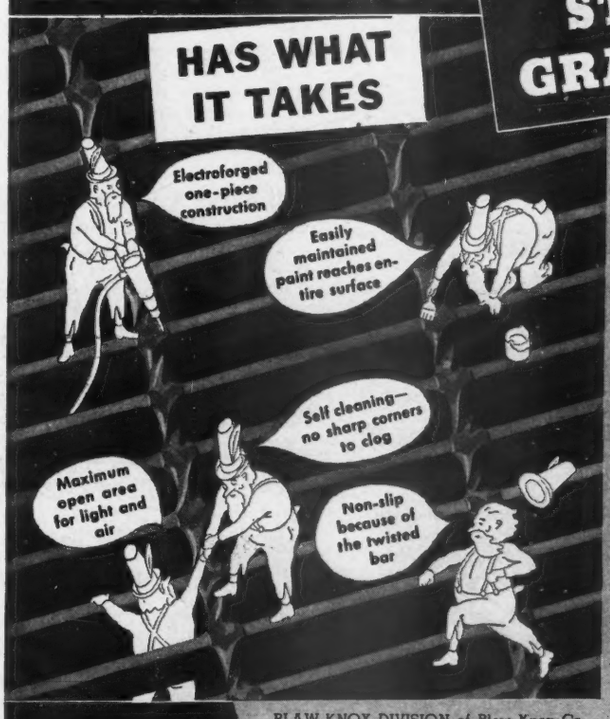
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